STATE OF MICHIGAN,

MINES

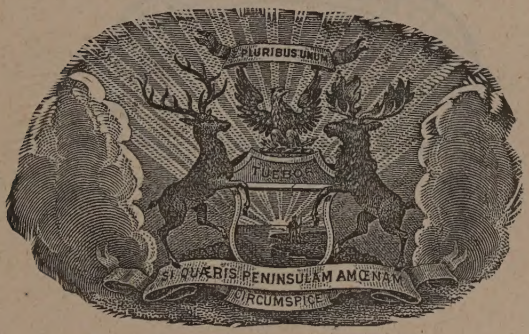
AND

MINERAL STATISTICS

BY

CHAS. D. LAWTON, A. M. C. E.,

COMMISSIONER OF MINERAL STATISTICS.



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STATE OF MICHIGAN,
OFFICE OF THE COMMISSIONER OF MINERAL STATISTICS,
Lawton, Michigan, June, 1889.

HON. CYRUS G. LUCE,
Governor of the State of Michigan:

SIR—In fulfillment of the duties of my office, I have the honor to submit herewith the following report upon the mines and mineral interests of the State.

Respectfully your obedient servant,

CHARLES D. LAWTON,
Commissioner of Mineral Statistics.

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INTRODUCTORY NOTE.

In a scrap book I have a clipping, cut from a Detroit paper twenty years ago, in which the writer states, to quote his own words, "We want to know more about the Upper Peninsula; how rich its ores are, how they lie, where they are to be found, and what chance there is for working them." "We want more definite and satisfactory knowledge about the mines in that region." "There are fifteen or twenty copper mines in the Keweenaw peninsula, but very few persons have any definite information about them." "At one time we hear of their surpassing richness, what masses of solid copper are taken from their depths, and what a large percentage of silver." "And thus, when encouraged to expect a dividend on shares already held or be led to invest our savings that we may become shareholders, we are again told that the machinery is idle, that the workmen are discharged, and the locations are becoming a desert." "There are not fifty men in Michigan today who can be sure that it is safe to invest money in the copper mines or in the iron mines of this State." "We want to know all about these mines ourselves, and we want to make them known to the world." "We want to invite foreign capital to aid in developing our resources, and to give definite information." "We want to know, not only the extent and richness of the ores and other minerals, but also whether the land is worth anything without the minerals, or if it ever will be." "This region, the northern peninsula of Michigan, lies directly in the track of the Northern Pacific Railway, on which the future course of our empire is to run, and therefore it behooves us to know something about it."

The knowledge asked for by this writer many years ago is, in substance, the information which I have endeavored to impart in this and in previous reports.

In a mineral region like ours, that is constantly developing and each succeeding year is assuming greater importance, there cannot, in the nature of things, be such a matter as a finality of information. All science is cumulative, and this is especially true of mineral exploration, mining and geological work. Practical results are attained by the slow and laborious accumulation of facts. Every fact is a stepping-stone, but it takes many, and these

carefully weighed, to furnish the data for true conclusions. It is my effort to investigate the facts from year to year that are brought to light in exploring and mining work in this State, and to arrange and chronicle them in convenient form for present use and for future reference.

There is a vast amount of money expended annually in the Upper Peninsula in exploring for mineral; some of this work is successful, much of it proves abortive; but in any event there are in many instances valuable scientific facts developed which it is important to preserve. They are generally useful now, and are sure to be wanted in the future. They form the nucleus for the subsequent aggregation of similar facts.

It has been my purpose to set forth in a concise and reliable form such information regarding the mineral resources of the State as I have judged would be of most practical value, such as shall enable any one to form definite and correct views of our vast and rapidly developing mineral wealth. I do not expect to produce an exhaustive report, but I visit annually every mine in the State, and have within the past year been under ground and examined, with scarcely an exception, every mine and exploration that is in operation; some of them more than once—several times. I mention this to show that the report is not made up from hearsay. It is altogether written out from my own notes of observations made on the ground. As heretofore I have gathered full statistics of products, and have reported to the Auditor General such as are subject to specific taxes and the amounts to be paid thereon.

CHARLES D. LAWTON,
Commissioner.

THE COPPER INDUSTRY.

THE COPPER INDUSTRY

has experienced the extremes of fortune within a brief period. Nevertheless, the year 1888 was an unusually profitable one for the copper mines of our State, as is evident from the fact that the seven leading mines paid an aggregate of dividends to their stockholders during the year of $3,500,000.

From about the close of the year 1884 to December, 1887, the market value of Lake Superior copper in New York ranged at about 11 cents per pound —sometimes at 10 cents; and during 1887, previous to December of that year, the price scarcely got above 10½ cents. Naturally so long a period of very low prices was damaging to the interests of the mining companies. Our copper mining companies are used to the practice of economy. They have learned to trace the cost of the, apparently, most insignificant items, and are equal to moderately depressed periods. That is, they can easily survive a time of low prices if not too long endured. But 10 or 11 cents per pound is too low a market price for copper for all but a few of the mines to work at all. The Calumet and Hecla, Tamarack and the Quincy, being richer mines, can be worked at a profit with copper even at 10 cents and even less; but with the others such a condition of the market forces them to the wall. The margin is too small to insure them profit and prosperity. But in December, 1887, the price of copper advanced to 17 cents, and subsequently, through the action of the French syndicate, that was formed to control the copper production of the world, the price was maintained at above 16 cents throughout the year. The outlook for the copper producers seemed very bright, since the syndicate, holding apparently unlimited resources, had entered into contracts with the mining companies for their products for three years from May, 1888, at the minimum price of 13½ cents per lb.; all the net amount derived from sales at prices above that, to be divided equally between the companies and the syndicate. The syndicate seemed to have all the financial ability necessary to maintain its contracts. The future could be forecast pretty accurately, that is, so far as the production and consumption of copper is concerned; but, unfortunately, the market price of copper was maintained at so high a figure as to greatly stimulate production and to diminish consumption. The result was that at the close of the year 1888 there was an estimated surplus of copper in our markets, unsold, of 78,000,000 of lbs., against about one-half of that amount on hand at the end of the previous year.

Soon after January 1, 1889, it became apparent that the syndicate had a bigger load than it could carry, that unless something was done to

relieve its responsibilities it must inevitably succumb to the pressure of the unfortunate conditions, which foreshadowed its ruin. Much has been said, many plans suggested, but what was really done to relieve the situation, if anything at all, is of no consequence now—March 20—since the syndicate has collapsed. Naturally there is considerable loss somewhere, though it is believed that it falls largely on the syndicate itself. The mining companies that sold their copper at a large price, and received their pay, cannot be sufferers, so that the greatest part of the loss must fall on the French people who were the holders of the stock of the syndicate. The contracts were all made in the name of *Societe des Metaux*, and the outcome is that the society is probably utterly ruined. And in the unfortunate collapse of this most important copper manufacturing concern is also involved the bankruptcy of the Comptoir d' Escompte, which, with a single exception, is the largest banking concern in France.

Besides these there is much embarrassment even if not utter ruin in other lesser establishments.

The syndicate has had an existence of about ten months; it took all the copper on hand in this country at the time, so that it absorbed and controlled all the copper production of 1888. It has been the means of promoting the temporary prosperity of the copper producers, and has, no doubt, enabled them to recover, in part, from the effects of the previous year's depression, It has stimulated the opening of new mines to some extent, and the greater development of those already in operation.

The great rise in the price of the stocks has no doubt enabled some people to make money. Those who bought before the advance in prices and who sold before the decline have profited by the circumstances; but those who sold their stocks and who perhaps bought when the price was up will now chew the bitter cud of disappointment and reflect on the mutability of human expectations. This combination to control the copper production of the world has held a large share of public attention everywhere. It created an abnormal condition that in the nature of things could not long endure. The inevitable tendency of its course was to increase the surplus of copper in the world and finally to augment its proportions so greatly as to make it beyond the ability of any combination of capital to carry it. On the whole I do not think it has been of advantage. Experience is worth something, and it has helped in that way. Mining companies have received more for their copper, etc., and have been able to pay larger dividends and to make needed improvements, etc. On the other hand, money has been advanced under the stimulation of high prices and the expectation of their continuance, to start up mines that cannot now be profitably worked; men have invested in stocks

at prices which cannot, probably, again be realized, and thus they are losers.

The consumers have been forced to pay a price for the metal which was beyond its legitimate value—a price that was maintained by the *fiat* of the syndicate. It is useless to speculate what the result will be. The mining companies of Lake Superior are not likely to be sufferers beyond the falling off in price. They are not involved in the ruin only to that extent. They must keep on as before, and take for their copper such prices as they can get. Copper, like everything else, must take its chances in the world's markets, and I do not think that the copper men of our State ask for or expect anything else. They were willing to accept whatever of good fortune might come, but to my knowledge there are men connected with our large copper mines who deprecated the action of the syndicate in placing the price of the metal so high, and who predicted the result which has arrived.

I read a private letter written by the agent of a leading copper mine in this State, last July, in which he accurately portrayed what has since transpired in the copper world.

It would seem to be demonstrated that a market price of 10 to 11 cents per pound for lake copper will not result in sufficiently keeping up production while an abnormally great price will stimulate an over production. Under the low prices of 1885, '86 and '87, a condition of the market was finally reached when the inevitable law of supply and demand caused the advance in the market. The first ten months of 1887 the average price was but 10½ cents, but in December it had gone up to 17 cents, a price which was afterwards sustained by the action of the syndicate. The syndicate controlled 80 per cent and upwards of the copper of the world and thus could dictate what the price should be. The contracts with the mining companies varied somewhat, but in every case the syndicate fixed the market price.

It seems strange that a scheme of such magnitude, organized with so much openness and care; a plan requiring such a vast combination of capital, which was secured, and so much financial ability, should have so quickly collapsed. And that its ruin should have been caused by inherent weakness, by the continuance of a policy of abnormally high prices that any tyro could have foreseen, would bring about the result that has transpired. The ability, which could combine so much, one would have supposed, would have been sufficiently far-seeing in its policy to have avoided being stranded on shoals whose position was so obvious. It overreached itself by making the profits of copper mining too great, thus too greatly stimulating production and causing a diminution of consumption resulting in a constantly increasing surplus of the metal which it was obliged to take and to hold. No combination of capital, however large, could long sustain such a strain.

Dividends paid by Lake Superior Copper Mines in 1888, and the aggregate dividends of those companies.

Name of Company.	Dividends in 1888.	Total Dividends to date.	Market Value of stock, Jan., 1889.	No. Shares of stock.
Calumet and Hecla	$2,000,000	$31,350,000	$29,800,000	100,000
Atlantic	120,000	480,000	720,000	40,000
Central	70,000	1,890,000	400,000	20,000
Franklin	160,000	800,000	640,000	40,000
Osceola	150,000	1,172,000	950,000	40,000
Quincy	360,000	4,970,000	3,400,000	40,000
Tamarack	640,000	640,000	6,280,000	40,000

The following valuable tables are largely taken from the Engineering and Mining Journal of N. Y., published in its issue of January 12, 1889.

Copper Production of Arizona.

	1884.	1885.	1886.	1887.	1888.
Copper Queen	7,700,000	6,721,535	3,800,000	5,945,550	9,379,949
Old Dominion	7,400,000	4,688,640	4,567,665	1,444,770	4,870,000
Arizona Copper	3,760,000	6,832,880	5,250,000	5,714,000	7,133,188
Detroit	2,940,000	3,456,000	2,135,000	4,404,321	5,420,224
United Verde	3,680,000	----------	----------	272,124	3,200,000
Other mines	1,254,345	1,007,301	----------	----------	3,196,639
Total	26,734,345	22,706,366	16,000,000	17,790,000	32,200,000

Copper Production of Montana.

	1884.	1885.	1886.	1887.	1888.
Anaconda	23,000,000	34,000,000	33,267,864	57,000,000	63,245,473
Parrot	9,300,000	9,809,000	10,000,000	10,000,000	10,750,000
Boston-Montana	6,600,000	7,500,000	500,000	1,500,000	18,273,667
Liquidator	----------	----------	1,500,000		
Clark's	600,000	10,000,000	7,000,000	7,100,000	700,000
Butte Reduction Works	2,000,000	2,500,000	1,700,000	1,565,000	3,521,565
Williams	----------	1,200,000	2,000,000	1,500,000	*1,485,000
All others	1,593,054	793,864	1,643,621	----------	521,295
Total	43,093,054	67,798,864	57,611,485	78,700,000	98,500,00

* The Colorado Smelting and Mining Company.

Summary.

	Pounds.		Pounds.
Lake Superior	86,840,000	Domestic production	231,000,000
Arizona	33,200,000	From imported ores	5,000,000
Montana	98,500,000		
New Mexico	2,000,000	Total production	236,000,000
Colorado	3,000,000	Stocks December 31, 1887	40,000,000
Utah	2,500,000		
All other sources	4,960,000	Available supply	276,000,000
Deduct exports in ore, matte, ingots, etc.			78,000,000
Consumption in 1888			120,000,000
			198,000,000
Stocks on hand December 31, 1888			78,000,000

The quantity of electrolytic copper produced was about 17,000,000 pounds.

Copper Production of the United States.

	1882.	1883.	1884.	1885.	1886.	1887.
Lake Superior	56,982,765	59,702,404	69,353,202	72,148,172	79,890,798	75,471,890
Arizona	17,984,415	23,874,963	26,734,345	22,706,366	15,657,035	17,720,462
Montana	9,058,284	24,664,346	43,093,054	67,798,864	57,611,621	78,699,677
New Mexico	869,489	823,511	59,450	79,839	558,385	283,664
California	826,695	1,600,862	876,166	496,028	430,210	1,600,000
Colorado	1,494,000	1,152,652	2,013,125	1,146,460	409,306	2,012,027
Utah	605,880	341,885	265,526	166,199	500,000	2,500,000
Wyoming	100,000	962,468				
Nevada	350,000	288,077	100,000	8,871	50,000	
Idaho			46,667	40,381		
Middle States	294,695	324,706	232,114	190,000		
New England	1,555,000	612,124	904,423	211,602	315,719	200,000
Southern States	400,000	395,175	317,711	40,199	29,811	
Lead refiners	125,000	782,880	950,870	910,144	1,282,496	2,432,804
Domestic production	90,646,232	115,526,053	144,946,653	165,875,766	156,735,381	180,920,524
Imported ores	1,000,000	1,625,742	2,858,754	6,056,841	4,500,000	3,750,000
Total production	91,646,232	117,151,795	147,805,407	170,962,607	161,235,381	184,670,524
Stocks, January 1			30,000,000	30,000,000	35,000,000	40,000,000
Available supply			177,805,407	200,962,607	196,235,381	224,670,524

The home consumption of copper amounted to about 120,000,000 lbs. Total domestic production 231,000,000 lbs. The total value of raw and manufactured copper exported from the U. S. in 1888 was about $11,500,000.

Average price per pound of Lake Copper at New York.

Year.	Jan. cts.	Feb. cts.	Mar. cts.	April. cts.	May. cts.	June. cts.	July. cts.	Aug. cts.	Sept. cts.	Oct. cts.	Nov. cts.	Dec. cts.	Year. cts.
1860	23¾	23⅞	23⅜	23¾	22⅞	22⅛	21⅝	21½	21⅝	21¾	20⅞	20	22¼
1861	19⅜	19¼	19⅜	19⅜	19⅜	18⅜	17¾	18⅜	19⅝	20⅛	21¾	24¾	19⅛
1862	27⅛	26⅛	24	22¼	21⅛	21⅞	23⅛	24¼	25⅝	29⅞	31⅝	31	25¾
1863	33	36	34	30⅜	30¼	30¼	30⅜	30	31⅝	33⅜	36¾	38⅝	32⅞
1864	40⅞	41⅝	42	43¼	43⅛	46⅜	59¾	51¼	50	47⅜	48	49¼	46¼
1865	48¼	45	39¼	34⅛	32	29⅜	29⅛	31⅛	31⅞	32⅛	39⅛	42⅜	36¼
1866	40	36¾	32⅛	29¼	29⅞	33⅜	32¼	30⅝	31⅛	30⅞	28¾	27¾	31¾
1867	28⅛	27⅛	25¾	24	24⅛	24¼	25	26	26¾	24¾	22⅞	22⅝	25⅛
1868	22⅛	23¼	23⅛	23¾	24⅛	23⅝	23¾	24⅛	23⅞	23⅛	23¼	24⅛	23⅝
1869	25	26⅛	25⅜	23⅝	24	22⅞	22	22⅛	22⅛	22⅜	22¼	21¾	23¾
1870	21⅜	20⅞	19¾	19⅛	19	19¾	20⅜	20⅛	21⅛	21¾	22¼	22¼	20⅝
1871	22⅛	21⅞	21⅛	21⅛	21¼	21⅜	22⅛	22¾	23⅜	23½	21⅛	20⅛	22⅝
1872	27¾	28⅜	33	41¼	36½	33½	33¼	33½	33⅛	32⅛	31⅜	32¼	33
1873	34¼	34⅝	34¼	33¼	31⅛	29¼	27¾	27⅛	26	23¼	22⅛	24¼	29
1874	24¾	24⅝	24⅜	24⅞	24¾	24⅜	21⅞	20	21⅛	21¾	21¾	23¼	23¼
1875	22¼	22¼	21⅜	21⅛	21⅛	22¾	22¾	23	23¼	23⅛	23	23⅜	22⅛
1876	23⅛	23⅝	22	22	21⅞	20	19¾	19	20	20¾	20¼	19¾	21
1877	19¼	19¼	19¼	19⅜	19⅛	19⅛	19	18⅛	18	17⅞	17⅝	17⅝	18⅝
1878	17⅛	17¼	17	16⅞	16⅛	16¼	16⅛	16⅛	16	15¾	15⅝	15⅞	16⅛
1879	15¾	15⅛	15¾	15⅞	16	16⅛	16	16⅛	16⅛	19⅛	21⅛	21¼	17⅛
1880	23	24⅛	23¼	21¾	19	18⅛	18½	19	18¾	18¾	18¾	19	20⅛
1881	19¼	19¼	19⅛	18⅞	18⅛	17	16¼	16⅜	17⅛	18⅛	18⅛	19¾	18⅛
1882	20¼	19⅛	19	18⅞	18⅛	18⅛	18⅛	18⅛	18⅛	18⅛	18	18	18⅛
1883	18	17¾	17¼	15⅞	15⅞	15⅛	15	15	15⅛	15⅛	15	14⅞	15⅞
1884	14⅞	14⅞	14⅞	14⅛	14¼	14⅛	14	13⅞	13⅛	13	12¾	11⅝	13⅞
1885	11¼	11⅛	10⅞	11	11⅛	11⅜	11⅛	11⅛	11⅛	11	11	11¼	11⅛
1886	11⅜	11⅜	11⅜	11⅜	10⅜	10	10	10	10⅜	11¾	12	12	11
1887	11⅝	11	10⅜	10¼	10	10	10⅜	10⅜	10⅜	10⅜	12⅝	17	11¼
1888	16¼	16⅜	16⅛	16⅝	16⅝	16⅛	16¾	16¾	17¼	16⅛	16⅛	16⅛	16¾

Fluctuations of Prices of Mining Stocks in Boston during 1888.

Name and location of company.	Par value.	January.		February.		March.		April.		May.		June.	
		H.	L.	H.	L.	H.	L.	H.	L.	H.	L.	H.	L.
Allouez, Mich.	25	2.50	1.50	3.00	2.00	2.13	1.50	1.75	1.25	1.75	1.00	1.13	.50
Atlantic, Mich.	25	15.50	12.75	20.00	15 25	19.00	17.00	18.00	17.00	18 00	17.00	18.00	17.00
Calumet and Hecla, Mich.	25	216.00	190.00	250.00	208 00	249.00	235.00	243.00	230.00	247.00	237.00	244.00	239.00
Central, Mich.	25			24.00	8.00	20.50				20.25		20.00	
Franklin, Mich.	25	15.25	13.00	17.00	14.50	16.00	13.00	15.37	12.75	15.50	14.50	15.50	12.13
National, Mich.	25	3 31	2.00	4.00	3.00	3.50	2.00	2.00		2.50	2.00	2.25	2.00
Huron, Mich	25	5.50	5 00	5.50	5.00	5.25	4.25	4.75	4.00	4.50	4.25	4.50	4.00
Kearsarge, Mich.	25	7.75	5.25	8.88	7.25	8.00	7.00	7.25	6.25	7.00	6 00	6.75	5.50
Osceola, Mich.	25	25.00	20.00	27.00	23.37	24.25	20.50	23.00	19.00	23.00	20.50	21.50	18.25
Pewabic, Mich.	25	2.25	2.13	3.25	2.00	3.00	2.25	2.75	2.50	2.75	2.50		
Pontiac, Mich.	25	.50	.40	.30	.25	.30	.25						
Quincy, Mich.	25	64.25	60.00	73.00	61.75	71.50	68.00	70.00	67.00	77.00	69.00	72.63	69.25
Ridge, Mich.	25	3.88	2.00	3.00	2.50	2.00	1.75	1.75	1.50				
Rockland, Mich.	25												
Tamarack, Mich.	25	165.00	122.00	172.00	151.00	171.50	165.00	151.00	140.00	165.00	150.00	165.00	150.00

Name and location of company.	July.		August.		September.		October.		November.		December.		Sales.
	H.	L.	H.	L.	H.	L.	H.	L.	H.	L.	H.	L.	
Allouez, Mich.	3.25	.63	3.13	2.13	3.75	3.00	6.13	3.38	5.63	4.00	4.50	3.75	123,926
Atlantic, Mich.	17.75	16 00	17.00	16.50	18.50	17.00	20.50	18.00	20.38	18.00	18 50	17.63	27,835
Calumet and Hecla, Mich.	271.00	239.00	275.00	265.00	299.00	265.00	320.00	293.00	324.00	255.00	300.00	258.00	19,182
Central, Mich.	20.00		20.00		19.00		21.00	20 00					675
Franklin, Mich.	22.25	11.75	23.00	17.50	21.50	17.75	21.00	17.25	19.25	16.75	18.25	15.50	91,304
National, Mich.	3.50	2.00	4.50	2.75	6.25	4.38	9.75	5.00	9.00	8.00	9.00	7.50	58,510
Huron, Mich.	6.38	3.88	6 50	5.00	6.00	5.00	8.00	4.75	7.50	5.50	6.25	5.50	43,120
Kearsarge, Mich.	7.50	5.75	8.75	6.25	10.00	8.63	16.50	9.75	14.00	12.13	12.50	10.00	109,339
Osceola, Mich.	22.00	18.00	22.00	20.00	23.00	19.75	23 00	19.13	23.00	21.00	21.00	17.50	40,863
Pewabic, Mich.	3.00	2.00	3 63	3.00	4.00	3.50	5.75	4.00	6.50	4.75	6.00	5.75	27,840
Pontiac, Mich.					.30	.20	.65	.30	.40		.40	.35	9,665
Quincy, Mich.	75.00	68.50	75.00	72.00	85.00	75.00	90.00	83.00	88.00	84.00	86.00	79.00	13,729
Ridge, Mich.			1.75	1.31	2.50	1 63	3.00	1.75	2.25	1.50	2.25	2.00	29,029
Rockland, Mich.							1.50						100
Tamarack, Mich.	165.00	152.00	174.50	163.00	187.00	173.50	183.00	175.00	182.00	170.00	175.00	156.00	7,623

In January, when it was known that there was a large surplus of copper on hand, and that this quantity was continually augmenting, public confidence in the stability of the syndicate became shaken, and thenceforward copper stocks continually depreciated in value until now, April 18, 1889. The Boston stock report is as follows:

Calumet and Hecla	$202 00
Franklin	9 50
Quincy	45 00
Atlantic	9 00
Allouez	1 00
Huron	2 00
Tamarack	105 00
Pewabic	3 00
Osceola	9 50
Kearsarge	5 00
National	2 00
Boston and Montana	28 00
Santa Fé	60
Ingot Copper	17 00

What will be the outcome in the copper situation it is impossible to tell. The mines are producing right along and holding their copper. They are waiting for events to shape themselves. Probably a conference will be had representing the general copper interests of the world, that will seek to adopt a uniform policy of production and sale that shall harmonize, as much as may be, conflicting interests.

No doubt that the plan that is the best is one that shall proportion production to consumption so that a living price for the mines will be naturally maintained. Twelve or thirteen cents per pound would be a fair price, and the mines could prosper on that, and would be satisfied. The solution of the problem rests with the large producers, and they are few in number. The smaller producers, those mines in low grade rock, are of equal importance to the laboring class, for they employ as many men and pay as good wages as the richer mines. A policy that shall sustain the weaker companies, that is the companies that have demonstrated their right to exist, is the best one. The Calumet and Hecla and the Atlantic, for instance, are so far apart in richness of rock that it would seem at first glance impossible to harmonize their interests, but the latter can live and make a little money when the other could prosper and make a great deal. The consumption would not be lessened were the market price fixed at say 12½ cents per pound, and such mines as are worth working, under the circumstances, could keep even with the world and make a little money.

It would be exceedingly short-sighted policy, it seems to me, for the mining

companies, having once effected a combination and learned its value, to sacrifice all the advantages and benefit of it. It would be ruinous for them, in the present glutted condition of the market, to keep up the maximum production and to throw the copper upon the market and still further weigh down what even now cannot be floated without the control that holds. The syndicate lived up to its promises and contracts to the last. It never appealed for help. It seemed to inspire a certain amount of confidence from the very fact of the brave face it maintained to the world. One can scarcely realize that it has collapsed. Some preliminary signs of dissolution were looked for, some efforts made for recovery; but the great copper combine held out to the last and gave up without a struggle.

ONTONAGON COUNTY MINES.

FEBRUARY, 1889.

Just now Ontonagon county seems to be rather quiet, especially at the villages; many of the men are in the woods on homesteads or cutting and drawing logs for the Diamond Match Co.

At nearly all the mines in the Evergreen range a few men are working and, for the effort made, are obtaining good results; but the properties here are too restricted for the modern methods of copper mining on Lake Superior. There are mineral veins, so called, in this portion of the range that are fairly well charged with copper, in which it is reasonably certain that mines could be opened and worked to a profit. Both the Evergreen and Knowlton veins are well defined and wherever worked have yielded what is now considered a fair percentage of copper. In the former are the Evergreen Bluff and Ridge mines and both have yielded a good percentage of copper to the fathom of ground. The former has not, until recently, been worked for many years; but within the past year a party has obtained a lease of the property and pumped out the water from the mine and secured 23,888 lbs. of copper, all in mass and barrel work.

The Ridge mine is, comparatively with the mines in Houghton county, a small affair, but it has yielded in round numbers 2,600 tons of copper.

The Ridge, Evergreen Bluff and Merrimac are contiguous properties, so situated as to embrace all the known lodes in the district, and, combined, would comprise an estate that would be worth operating.

Still better than the Evergreen vein, doubtless, is the Knowlton, which has been the most extensively worked in at the Mass mine, and also explored to a more or less extent at the Knowlton, Ogima, Hilton and Belt mines.

The Mass is a small mine but it has yielded 2,500 tons of copper, and has

proved that the Knowlton lode is a good one. The mine afforded, regularly, a uniform yield of copper. Copper in large and small masses is found along the foot wall, and there is also afforded a good amount of stamp rock. Just now in the bottom of the Mass mine is exposed a fine run of stamp rock for which the men who are working it have no use, as the stamp mill is not available. The stamp mill was never a very effective affair at best, and having been unused for several years, it is much out of order. There are situations in Ontonagon county, and it may be true of other localities, where the soil is lacking in stability; becoming saturated with water it is like a semi-fluid, susceptible of movement as occasion offers. The location of the Mass stamp mill is of this character, on the level ground between the bluffs that border the valley. The water, which penetrates the soil, holds it in such partial suspension that the blows of the stamps tend to unsettle the foundations and also to gradually enable the water to penetrate beneath the dam and carry it away, which it has done several times, notwithstanding the precautions that were taken. The same difficulty was experienced at the new stamp mill at the National mine. It was found that the fine clay loam, when it was wet, had little stability, and it was with exceeding difficulty that foundations sufficiently permanent, were finally secured. Even then the floor of the wash-house, which had been constructed to rest upon the earth—properly "hammered"—with which the space within the exterior foundation walls had been filled, very soon settled out of place when the mill was started up. The soil became like wet mortar and necessitated the raising of the floor timbers into place and the building of a stone foundation through the center.

The Mass and Knowlton are contiguous mines, the former on the east; and still further east joining the mass is the Ogima. These three mines, with the Hazzard, which latter the Mass company already owns, if combined under one management, would make a fine mining estate. Thus consolidated and properly worked, there is every reasonable assurance that the enterprise would be a profitable one. The situation is admirable for economical working, and sufficient water for two heads of stamps and a good situation for a mill could be secured by going down the valley about a mile and a half to the Flint Steel river at the point of its junction with the several streams that are the drainage outlets of this portion of the range.

At the Hilton four men are working on tribute in the Knowlton vein, and have a good showing of copper now.

At the Adventure three men have a lease of the mine and are putting up a Krause pneumatic stamp and separator, to work over the rock that was accumulated many years ago. They have their arrangements well under way.

It seems to be quite possible that the Belt company will resume work in

the Knowlton vein during the current year. An English gentleman, interested in the property, visited the mine not long ago and expressed himself as deeming it the part of wisdom to further explore the ground; so much money had been expended on the surface, it were probably better to go on and raise some more money to ascertain if something could not be found beneath it to pay for all the outlay. He is endeavoring, it is said, to carry out this plan.

Of course the chief mining interest in the Ontonagon district at present is

THE NATIONAL MINE,

which is now fairly on the tapis to be thenceforward a regular producer. The National is one of the old mines of the county, and was once a profitable one. It is conspicuous in the early mining history of the country as one of the few well managed and paying enterprises. The National was a large producer of mass copper; it proved profitable from the start, and the owners were called upon for but very little to open the mine, and in the end received back in dividends nearly $4.00 for every one which they had been called upon to advance. But little use was made of the stamp rock; in fact, in the vein which was worked not much stamp rock was found; it was nearly all mass and barrel work, meaning by the latter the small pieces of copper obtained, which were too small to be included under the term mass. A portion of this mine proved very rich indeed, and the succession of great masses that were found here and in its neighbor, the Minesota, were among the marvels of this very wonderful country.

Naturally they served to stimulate effort to a high degree, and great mining activity prevailed throughout that region. Mines innumerable were opened and worked for a while, some of which absorbed a great amount of capital, but nearly all resulted in disappointment and failure. These two only, the National and the Minesota, situated side by side, are almost the only mines that redeem the mining history of Ontonagon county from a record of total failure; but the wealth of these two was of such a remarkable character that they can never cease to be of interest. The situation at the National is an exceedingly interesting and pleasant one. The topography is romantic and attractive; from the summit of the elevation at the mine the surface to the north slopes gradually downward and again rises, far away in the distance, and also inclining gently downward to the west. In this broad synclinal is situated the pleasant village of Rockland amidst the surrounding fields of well kept and productive meadow lands. To the west, from the east end of the mine, the ground soon descends rapidly, making a total fall of upwards of 600 feet to the level of the Ontonagon river, a distance away of one and

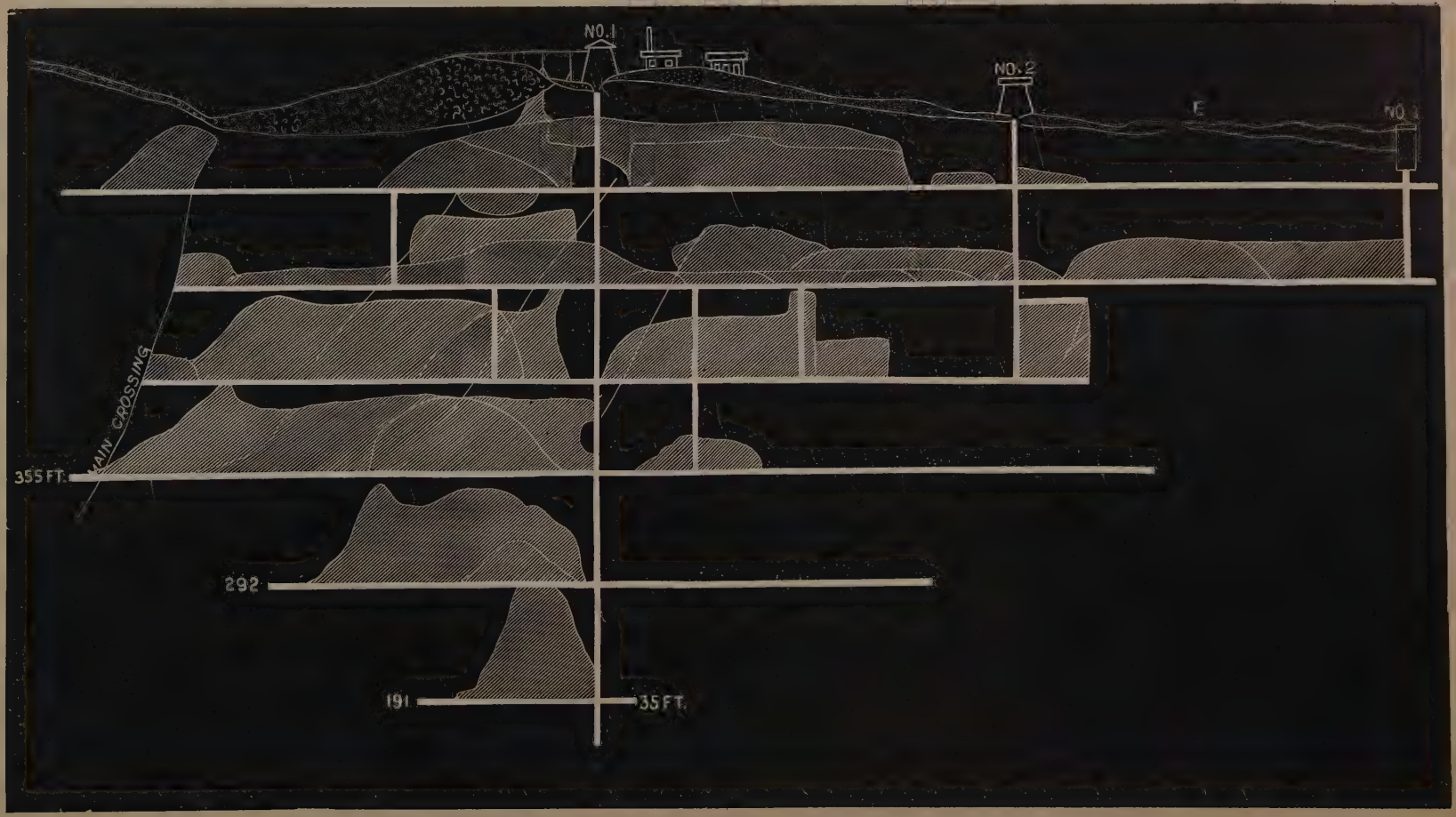
three-fourths miles; and beyond the river is exposed to the view a great expanse of the rugged and varied copper range, with its forests of pine trees and hardwood, its elevations and depressions, among which are reflected the lights and shadows of the setting sun as it disappears beyond the waters of the great lake that bounds the horizon in the west. A quarter of a mile to the south of the ridge, in which is the National mine, is the parallel and equally elevated peninsula bluff, and in the valley between these, through which courses the small stream on which was the former stamp mill, are placed the chief buildings of the company. It is the scene of the surface operations of the mine. Here are the agent's and other houses, office, shops and warehouse, etc., and a little higher up, on the side of the bluff, are substantial stone engine and boiler house, compressor house, machine shop and the new rock house, from which extends the track that conducts the cars to the head of the incline down which they speedily descend to the stamp mill.

The trend of the formation is north about 65° east and the dip about 54° northwesterly; the old mine is in a vein of contact that outcrops along the side of the southerly slope of the bluff, and which is contained between an underlying conglomerate and the overlying trap; the gangue of this vein is chiefly quartz, calc, spar and epidote, and has afforded, in times past, many fine specimens of all these minerals. It is usually known as the conglomerate vein, and sometimes it is incorrectly supposed that the conglomerate yielded the copper; but the copper was invariably the product of the vein. Sometimes the vein matter penetrated into the conglomerate, and masses of copper were obtained in such places; but not otherwise was copper found in the conglomerate. A prominent feature of the old mine was what was called the counter vein, a branch of the main vein, which extended diagonally, northwesterly, across the formation to intersect an amygdaloid belt that is situated 140 feet north of the conglomerate and runs parallel with it. This counter vein was also productive in copper, and especially so along its lines of intersection with the main vein and with the amygdaloid. In the vicinity of these lines of intersection, in the upper levels, were found the richest portions of the mine.

The mine was owned and operated during the productive period of its history by what is known as the Pittsburgh company; the same parties who also owned and operated the Cliff mine, etc., and more recently the Mass. In 1870, it having become probable that further operations at the mine would lead to the necessity of levying assessments, the company decided to discontinue work on company account and let the mine on tribute, and as a result of such work succeeded in obtaining $40,000 in dividends. Thenceforward the mine was allowed to fill with water, in which condition it remained until

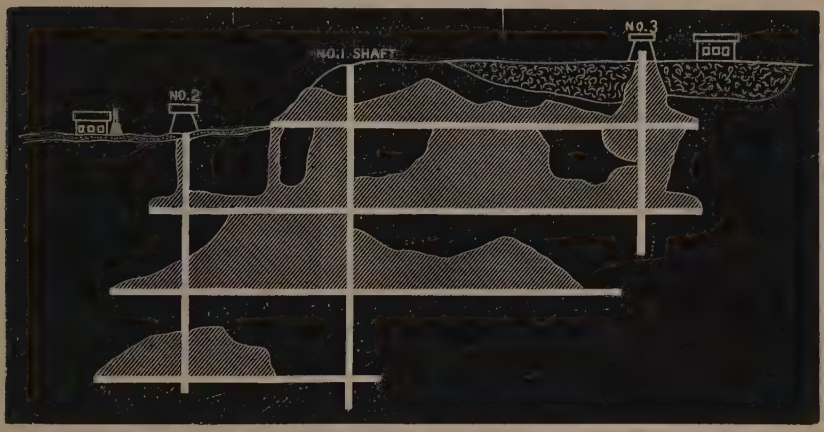
LONGITUDINAL SECTION OF THE MASS MINE, 1889.

Scale: 120 feet to an inch.



LONGITUDINAL SECTION OF THE KNOWLTON MINE, 1889.

Scale : 180 feet to an inch.



LONGITUDINAL SECTION OF THE EVERGREEN BLUFF MINE, 1889.

Scale: 250 feet to an inch.

1880, when the property having passed into other hands, work was resumed under the supervision of Capt. W. E. Parnall, the present local agent of the company. It will be remembered that Capt. Parnall undertook the task of restoring No. 2 shaft and of freeing the mine of water, a work which proved unusually difficult but which was finally accomplished. It was hoped that by sinking deeper and drifting on the vein better ground would be found than was afforded in the old bottom of the mine, especially near the line of junction of the veins; at the same time a shaft was sunk in the amygdaloid lode and some drifting done for the purpose of further proving its value and determining whether it possessed sufficient magnitude and richness to justify the erection of a stamp mill in which to manipulate the rock. As the amygdaloid is a stamp lode, and the former company possessed but very primitive and meagre facilities for stamping, the lode was never worked and thus was of undetermined value.

To further explore the mine, and for other ultimate objects, it was decided to drive a long adit horizontally through the mine from the westerly side of the hill, commencing at a point 645 feet below what is called the Creek shaft, the most westerly sinking made by the old company. This adit is 3,960 feet in length, and its mouth is 183 feet above the river and about 4,130 feet east from it, and is made to be the gathering place for the water used in the stamp mill.

The new stamp mill is situated 640 feet distant above this point, near Creek shaft in a spur of the ravine, which forms the bed of the creek where it cuts through the steep declevity on its way to the river.

The rocks in the valleys and along the river are, generally, covered with soil, principally clay that has been triturated by the mechanical forces of nature to a great degree of fineness, so that a good deal of excavating had to be done to secure the requisite firmness for the foundations of the stamp heads. The mill is 25′x60′ and the wash-house connected with it is 142′x30′, well arranged and substantially built. The stamp head—16″ cylinder—is identical with those at the Huron; capable of crushing 175 tons per day—18 washing machines, wooden frames, and one slime table now in use. The water for manipulating the rock is at present brought from the river, where is a Gordon steam pump, size 18½ and 28x14x18. It draws the water from the river 17 feet, and forces it up into the mouth of the adit 4,130 feet distant and 183 feet rise, through a 12″ pipe. The water runs through the adit towards the mill into the Creek shaft, where it is pumped up into the mill by a machine a duplicate of the one at the river.

The water for the boilers at the mill is brought from the Minesota creek,

from a point 1,000 feet away. To secure a channel for this water a tunnel 310 feet long was cut through an intervening ridge.

A dam has been nearly completed across the valley nearly opposite the rock house, which will, when done, secure a large pond—a reservoir of water that will probably suffice to supply the mill for a considerable portion of the year. It will be conducted to the mill in a launder. In addition, Capt. Parnall has nearly completed a launder that will re-conduct the water escaping from the mill to the adit, to be again used for washing the rock; in this arrangement suitable provision is made to free the escaping water of the sand held in suspension.

The rock from the shaft is run on an elevated trestle about 100 feet long to the rock house, whence, after going through the breaker, it drops into the bin and from thence is drawn into cars standing on the track beneath. The cars run by the force of gravity over the track 1,600 feet in length, which has a down grade of 2 3-10 inches in a 100 feet to the head of the incline, where they descend 141 feet in a distance of 1,075 feet, and thence on a level of 80 feet, run into the mill. The descending loaded cars of course draw up the empty ones, and the matter is regulated by a suitable brake. From the head of the incline to the rock house the cars are drawn up by a horse.

The ground was first broken for the mill in June last, and it was started the 5th of December following; but there has not been as yet, full regularity in its work; many interruptions have been met with in various ways, caused in some cases, by the inexperience or incapacity of employes and more recently through the failure of the pump at the river to perform its functions—a fault which has been remedied, and when I last saw the mine all the machinery and all the departments of the work were moving nicely.

It is a far more difficult matter to inaugurate a mining enterprise of this kind in Ontonagon county than it is on Portage Lake. There are no foundries, shops or supply stores there from which to get castings, machinery or materials. Such things must be ordered from abroad, and without railroad connection there is much trouble and delay.

There are comparatively few skilled workmen, machinists, builders, firemen, etc. Men for important departments of such work must be brought in from elsewhere and cannot always be had at a few moments' notice; when it is desired to push the work rapidly forward, it may not be possible to obtain the proper men to do it.

All these difficulties Capt. Parnall has experienced in a full measure, in his recent operations at the National. Happily he is nearly "out of the woods and can now see daylight," as the saying is, and can enjoy a "let up" of his anxiety. I can see no reason why, from this time on, the National

should not have a uniform product of copper. The rock that comes up from the mine and goes to the mill is certainly well impregnated with copper. It is mostly a greenish colored amygdaloid, with copper well distributed through it.

The rock that they will treat will average, probably, 1 % to 1¼ %, and the mill will work up 150 tons per day. Should copper remain at 14 cents, they will more than meet expenses, certainly.

To get 1 % I think that they must select the rock, that is, must open well and stope only the good, and leave the poor rock standing in the mine.

All the rock has come from the openings, shafts and drifts, and there are many thousands of tons on hand now, which I inspected somewhat and was favorably impressed with. These burrows are conveniently placed for economic handling. A portion of the rock is beside the track and a slight further extension of the latter can be made so that all the rock may be crushed and easily loaded into cars. The exposure of the rock to the atmosphere, some of it for several years, has served in a measure to disintegrate it, or at least to tend to render it friable and more easily ground under the mortar.

The shaft is sunk to the depth corresponding to the 6th level in the old mine, about 100 feet from the surface on the dip of the formation. The bottom level is about 150 feet in length each way from the shaft, and the others are of much greater extent. The vein is narrow in portions of it, but sometimes expands to a width of 20 feet. Capt. Parnall states that it will average about 8 feet wide. The productive portion of the belt is between the intersection of the counter vein and the amygdaloid east of the Minesota boundary.

The length of this productive ground increases rapidly with each successive level downward, owing to the fact that the lines of intersection of the vertical plane through the boundary and the plane of the counter vein get farther and farther apart as greater depth in the lode is reached. Its length in the adit level is about 1,200 feet and increases in length about 150 feet in each lift downward.

The adit is in the 5th level—3,960 feet in length, driven in the conglomerate vein. Two crosscuts were made from the adit to the amygdaloid. The first one of which was driven at a point in the mine 600 feet east from No. 8 shaft; and the second one was made at a distance of 1,200 feet east of the shaft. This shaft is 2,275 feet west from No. 2, or 1,040 feet east of the Creek shaft or of the new stamp mill, and is 1,685 east from the mouth of the adit. At these crosscuts the amygdaloid belt was explored somewhat and was found to be worthless.

The amygdaloid is opened in four levels, designated respectively as the 20, 40, 50 and 60, and the shaft is on its way to the 70—twenty feet further down.

When the workings in the amygdaloid become deeper than the old mine, the latter can be reached and readily tested further down by means of cross-cuts, south from the amygdaloid, a much cheaper proceeding than further sinking No. 2 shaft. And it is nearly certain that mass copper will be found along the line of the crossing and counter vein, which were formerly so rich and productive in the upper levels, but gradually became poorer and unprofitable lower down, never, however, entirely failing to yield some copper.

The mine is well equipped every way. The houses and other buildings, old and new, are in good order. The engine and boiler house, at the mine, are of masonry and founded upon the rock. The new rock house has a foundation of masonry, upon two sides, 40 feet high, and the shaft houses, built by Capt. Parnall, are of the best. There is a powerful hoisting engine, a new Norwalk compressor, etc., etc., sufficing for all present demands. Some changes in the arrangements of the buildings are contemplated, which, when ultimately made, will be advantageous—as, for instance: Capt. Parnall suggests the building of a new engine house south of the rock house opposite the shaft, where water can be run into the boilers from the dam, and to use the present house for a machine and blacksmith shop.

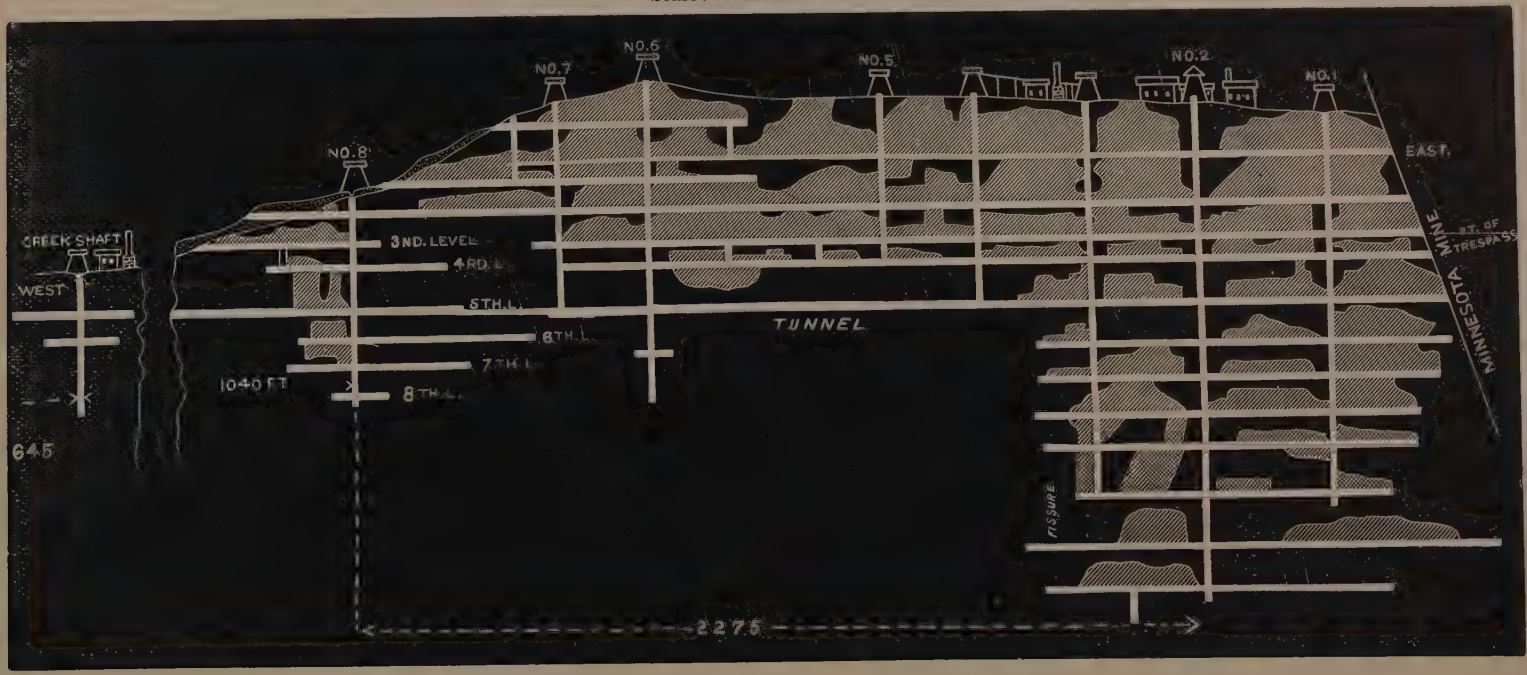
When the spring opens and the dam shall be completed, and the water be conducted to the mill in a launder, there will, of course, be a great saving of fuel, and other matters may be perfected tending to diminish cost and increase production.

So that looking over the whole situation, the efficiency of the machinery, the convenience of handling the rock already broken and hoisted, it would seem that the company should be able to produce copper cheaply. If the rock averages 1 % ingot, which is a safe estimate, and they manipulate 150 tons per day, as they may readily do, there will be a product of 3,000 lbs. per day, which, if it sell at 14 cents will give a gross income of $420, or for 26 days $10,920, which, after deducting all costs, should leave a margin of profit.

Capt. Parnall, the superintendent, is an energetic and intelligent mining man. He has been a miner from boyhood, and is fully equal to all demands upon his experience and ability that are required at the National. While there may have been delays in the work, they were inevitable to the situation, and have terminated as soon as energy and skill could accomplish it. Since the present plans were determined on by the company, he has labored incessantly to bring the enterprise to a successful termination, and one must

LONGITUDINAL SECTION OF THE NATIONAL MINE, 1889.

Scale: 300 feet to an inch.



"put himself in his place" to appreciate all the difficulties he has had to encounter and overcome.

Mr. Benj. F. Chynoweth continues to have charge of the books, etc., at the office.

Statement of Products of Mines in Ontonagon County in 1888, and for Previous Years.

Name of Mine.	Product in 1888.		Aggregate Production.	
	Tons.	Pounds.	Tons.	Pounds.
Adventure			590	57
Aztec			353	683
Caladonia			188	1,588
Carp Lake			15	1,135
Douglass			84	1,502
Evergreen Bluff	13	888	694	1,835
Flint Steel River			415	458
Hilton	7	631	52	1,046
Belt			333	1,772
Knowlton			323	1,993
Lake Superior			7	921
Mass	35	944	2,446	1,730
Minesota			17,352	668
National			5,453	1,764
Nonesuch			181	1,777
Norwich			496	1,360
Ogima			491	308
Trap Rock			20	1,185
Ridge	25	890	2,596	1,956
Rockland			3,105	309
Superior			283	1,331
Toltec			206	1,433
Victoria			166	1,279
Windsor			34	

ATLANTIC MINING COMPANY

maintains its record for economical work. Its rock yields a lower percentage than that of any other mine except the Copper Falls, and since 1878 the company has not failed to pay an annual dividend of not less than $20,000, and in 1887 $60,000, in 1888 $120,000. The average yield of copper to the ton of rock, last year, was but 13 lbs. The falling off in percentage is attributed by

Capt. Tonkin to the rock in the north end of the mine being less rich than formerly, or to the fact that they have been using more of it than heretofore, and that it is less rich than the rock from No. 3 shaft.

Some changes have been made in hoisting in the last year that are important to note. They have introduced a counter balance in each of the shafts.

The counter weight is simply a flat mass of iron weighing 7,000 lbs., with a hole through it to insert iron to increase the weight, if desired. The axles for the wheels extend through the mass, and the whole runs on a narrow track beside the other, the whole length of the shaft.

At No. 2 the hoisting machinery is in a small building that has been moved up to opposite the shaft. The boiler, two small engines and drums, all in the same room. One man attends to the whole, one man for each shaft, and Capt. Tonkin states that two cords of wood suffice for 24 hours. The drums are made at the mine. Skip part 12′ diam., and counter weight portion, 11′, weight of load 1½ tons of rock. Shaft now to 13th level. It is a simple enough hoisting plant, and, from Capt. Tonkin's statement, a very economical one. The Atlantic is probably the poorest copper mine in the world, that is profitably worked, and the good results are not secured by any large investments in new machinery. They do their work with the same hoisting drums and engines that were in operation away back in the days when all was failure and the mine was known as the South Pewabic. They splice the arms of the drums to increase the diameter and so save the cost of new ones. They face the wire rope schives with wood, properly grooved, because the U section iron facing wears the ropes more, and it costs more to buy ropes than it does to relay the schives. Capt. Tonkin declares that the engines at No. 2, which are 12″ x 18″, could not haul up the load 1½ tons, 1,300 feet maximum, without the aid of the counter weight. They have a model, from which a drum is making, designed by Mr. Frank Stanton, that is intended to balance the skip and counter weight at any point in the shaft.

No. 1 has a similar plant, similar to No. 2, equally simple and effective.

In the old hoisting house, near No. 4 shaft, one of the drums has been in use 10 years without change or repairs. It was made at Norristown, Pa., in an early day. The other, a duplicate of it, manufactured elsewhere, has been changed three times. Capt. Tonkin attributes the failure to last to want of attention given in construction to the necessity of allowance to be made for expansion and contraction. He thinks that the old drum is properly constructed in this respect, hence its durability.

One-half of a compressor has been added, made at Cleve's foundry, Houghton.

In the rock-house, by a slight change in the setting of the jaws of the large Blake crushers, they are made to do all the work, to break the rock to sufficient fineness without using the small breakers. Capt. Tonkin states that he thus saves $150 per month.

The rock-house is at the south end of the mine, a half mile south of No. 1 shaft; an elevated trestle extends all the way from the rock-house to the shaft. From No. 3 shaft south to the rock-house the track is double, and the rest of the way it is single.

The car starts at No. 1 with a skip load and stops at No. 2 for another skip load, when it goes on to the rock-house. The same way with Nos. 3 and 4—one car takes two skip loads each trip.

The cars open and discharge automatically at the rock-house. There is no delay. All the arrangements for filling, running and discharging the cars are excellent, and I have no doubt but the whole matter of the conveyance of the rock from the shafts to the rock-house, is as well accomplished as the situation will admit of. It only seeme to me, however, that it would be cheaper to do away with this long trestle entirely, and to crush the rock directly at the shafts, having a rock-bin at each shaft, and to run the railroad track along by the shafts to receive the rock into the cars.

At the mill, they are experimenting a little in solid bottoms to stamp dies. They use blocks of wood 1′x1′x15″, planed smooth, and with those and mortar make it as solid as possible.

With the price of copper at 12 cents and upwards, the Atlantic, under its present good management, is a profitable mine.

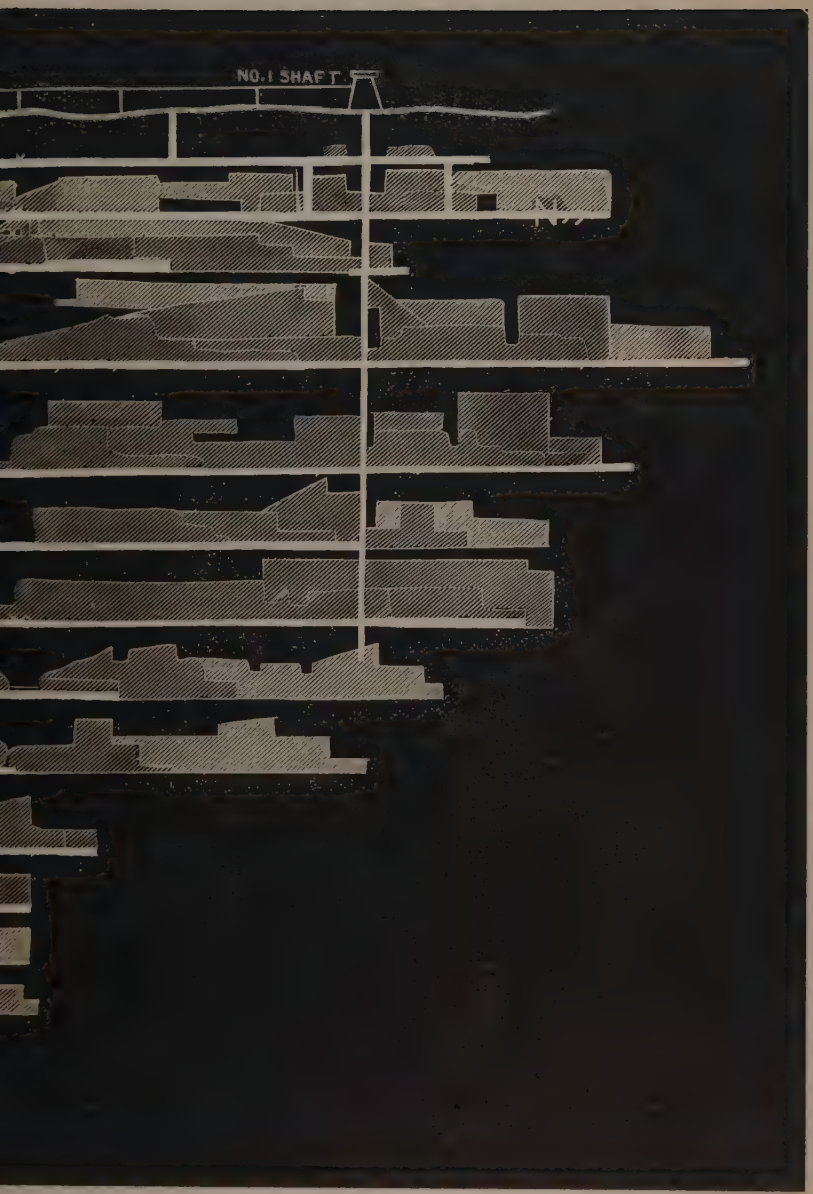
The following table gives the important results of the Atlantic mine's operations for the past 14 years:

	1875.	1876.	1877.	1878.	1879.	1880.	1881.	1882.	1883.	1884.	1885.	1886.	1887.	1888.
Number of tons of rock stamped	80,000	96,696	105,780	121,709	112,668	169,825	176,555	189,800	195,669	209,510	241,010	247,035	255,750	298,055
Yield of ingot per ton in pounds	19.58	18.99	19.42	18.50	19.00	14.27	14.36	13.866	13.708	15.1	14.86	14.18	14.24	13.34
Number of fathoms broken in mine	5,628	6,550	7,091	8,299	8,665	9,929	9,240	10,170	11,163	12,210	13,403	14,724	15,552	16,844
Yield of ingot per fathom, pounds	278	280	290	243	266	244	2,735	259	240	259	267	238	234	228
Cost in cents per ton for stamping and washing	87.96	67.09	57.79	48.85	42.44	38.13	42.54	37.07	35.25	39.95	30.36	26.53	27.31	26.89
Total cost per ton of rock mined, etc	3.90	3.58	3.08	2.78	2.33	2.25	1.96	1.9082	1.7789	1.71	1.436	1.2801	1.4522	1.1409
Total average cost per pound, ingot	$0.2212	$0.1895	$0.1637	$0.1683	$0.1220	$0.1584	$0.1368	$0.1376	$0.1256	$0.1087	$0.936	$0.908	$0.1020	$0.1070
Average price per pound received for copper	.2247	.2135	.1854	.1615	.1630	.1997	.1712	.1756	.1500	.1181	.1116	.1092	.1212	.1478
Dividends paid	------	------	------	20,000	30,000	40,000	80,000	80,000	40,000	20,000	40,000	40,000	60,000	120,000
Net profit per ton of rock	------	.44	.51	1.01	.87	.5000	.4711	.4958	.2483	.0919	.2205	.1529	.2706	.5436
Per cent. of copper in rock	.976	.949	.971	.925	.95	.713	.718	.693	.685	.755	.743	.709	.712	.667

There were 41,000 tons more rock sent to mill in 1888 than in 1887 without any increase of cost at mill except for fuel. The yield in ingot was one pound less per ton, but the cost of treating, etc., was less than formerly, and no increase in any other items. So that the falling off in percentage of yield does not make any figure.

LONGITUDINAL SECTION OF THE ATLANTIC MINE, JAN. 1, 1889.

Scale: 300 feet to an inch.


NO. 1 SHAFT

ATLANTIC MINING COMPANY'S ANNUAL REPORT.

The directors present the following report of operations during the year 1888:

The production of mineral was 5,383,910 pounds, which yielded 73 83-100 per cent, or 3,974,972 pounds of refined copper, which realized an average price of about 14 78-100 cents per pound.

The following is a summary of the year's business:

PRODUCTION.

3,974,972 pounds copper at 14 78-100c		$587,690 42
Add balance of interest account		5,592 18
		$593,282 60

COSTS.

Working expenses at mine as per clerk's tables		$340,045 78	
Freight	$15,041 54		
Smelting	38,030 67		
Expenses	6,866 22		
Brokerage	2,588 23		
Insurance	995 39		
Storage	319 70		
		63,841 75	
			403,887 53
Showing a mining profit in 1888 of			$189,395 07
There has been expended for additions to plant, as per detailed statement hereafter		$20,366 03	
There has also been expended for purchase of 200 acres of land		10,000 00	
And for explorations on section 16		1,430 37	
			$31,796 40
Leaving a net gain for the year of			$157,598 67
The surplus from 1887, after payment of dividend, was		$284,966 13	
Less dividend paid August 1, 1888		60,000 00	
			224,966 13
Making the net surplus December 31, 1888			$382,564 80

as shown in detail in the annexed statement of assets and liabilities, and out of which a dividend of two dollars pet share ($80,000) was paid Feb. 1, 1889.

The foregoing figures show an increase of production over that of the previous year, as well as a large increase in the average price obtained for same.

Although the advance in the price of copper caused an advance likewise in the wages paid to our workmen, yet the increase in the quantity of rock mined and treated has resulted in a further decrease in the average cost of treatment per ton, to the lowest figure we have yet reached, as shown by the accompanying table of results. The cost of the refined copper, has, however, been slightly increased by a decrease in the average yield of the rock to the extent of about 93-100 pounds copper per ton. It is difficult to account for this decline in the yield of the rock mined, but it probably arises from the fact that a large portion of the increased output was drawn from extensions of the upper levels, where the rock is somewhat poorer than in the deeper portions of the mine. As similar fluctuations in yield have occurred in former years, this change does not seem to be of any special significance.

We have made some explorations on section 16, which have exposed several belts of

amygdaloid, and conglomerate carrying more or less copper, but nothing of value has yet been met with. This examination is not, however, conclusive, as only a small part of the section has been explored. The advent of frost caused suspension of work at this point, but the exploration can be resumed whenever desirable.

We have purchased for the sum of $10,000 a tract of 200 acres of land adjacent to our mining location. The principal copper bearing belts of the "mineral range" should traverse this tract, but as they have not yet been located, nothing is known of their value. As a portion of the surface will shortly be required by us for building purposes, and as the entire tract has a prospective "mineral value," it was deemed best to secure it while we had an opportunity of doing so at a reasonable price.

The maps which accompany this report show the relative position of our mine and stamp mill and of the lands we have acquired from time to time. The lands along "Cowles Creek" and "Portage Lake" were purchased for the purpose of controlling and protecting the stream of water which flows by gravity into our stamp mill and those lying adjacent to the ship canal (about 2,000 acres) are held as timber reserve.

The improvements contemplated at the time of last report were only carried out to a partial extent, some changes in plans making it expedient to defer until this year the erection of a new hoisting plant at one of the deepest shafts.

The comparatively high prices obtained for our copper in the early part of the year and the satisfactory profits resulting from the business of the year, have enabled us to make fair returns to stockholders, besides providing for purchase of the lands named and carrying forward a surplus of about $17,000, towards paying for any extraordinary expenditures that may be necessary during the current year.

For details of the work performed, and its cost, we refer to the subjoined statements and summary of results. The report of our agent at the mine is also submitted.

JOSEPH E. GAY,
EDWIN H. MEAD,
JOHN STANTON,
ISAAC B. CRANE,
JOHN R. STANTON,
Directors.

New York, March 2, 1889.

ASSETS AND LIABILITIES, ATLANTIC MINING COMPANY, DEC. 31, 1888.

Assets.

Cash		$47,139 32
Accounts receivable		2,933 97
Loans		205,000 00
Copper on hand, sold		71,398 24
		$326,471 53

At Mine.

Cash	$2,206 30	
Coal	14,412 83	
Wood	14,919 40	
Supplies	34,112 62	
Merchandise in store	39,207 60	
		104,858 75
Total assets		$431,330 28

Liabilities.

Indebtedness at mine	$18,694 33	
Agent's drafts outstanding	6,818 27	
Accounts payable	23,252 88	
		$48,765 48
Balance of assets		$382,564 80

(Less dividend payable Feb. 1, 1889, $80,000.)

SUMMARY OF RECEIPTS AND EXPENDITURES OF ATLANTIC MINING COMPANY, FROM DATE OF ORGANIZATION TO DEC. 31, 1888.

Receipts.

Capital stock paid by consolidation	$700,000 00	
Capital stock paid by assessments	280,000 00	
		$980,000 00
Sales of copper		6,256,785 24
Other sources		853 15
		$7,237,638 39

Expenditure.

Real estate ("South Pewabic" and "Adams" mines, buildings, railroad, stamps, etc., as valued at consolidation)	$659,642 11	
Real estate (lands since purchased)	33,464 41	
	$693,106 52	
Net expenditure for additional equipment, mining operations, smelting and marketing copper, taxes and incidentals	5,681,967 07	
		6,375,073 59
Balance of receipts, being net profit to date		$862,564 80
Deduct dividends paid		480,000 00
Net surplus Dec. 31, 1888		$382,564 80

(As shown in detail in preceding statement.)

STATEMENT OF WORKING EXPENSES AT THE ATLANTIC MINE FOR THE YEAR ENDING DEC. 31, 1888.

Underground Expenses.

Sinking 93 feet, average $24.19 net		$2,249 96	
Drifting 3,912.4 feet, average $4.73 net		18,505 65	
Stoping 16,844 15-216 fathoms, average $4.31 net		72,599 91	
Timbering, tramming and labor		73,200 00	
Timber, materials and supplies		7,298 61	
Pumping and operating air compressors:			
Labor	$6,168 39		
Fuel	14,284 50		
Supplies and materials	3,925 37		
		24,378 26	
			$198,763 39

Surface Expenses.

Superintendence, and labor of all kinds (less sundry credit items)	$32,159 43
Supplies and materials	2,311 06
Fuel	14,696 74
Feed for teams, etc.	1,014 75
Fire insurance	390 00

Taxes	$3,143 67	
Canal tolls on copper	289 20	
Expenses and sundry repairs	970 39	
	$54,975 24	
Less amount received for rents	4,177 20	
		$50,798 04
Railroad Expenses.		
Labor	$6,626 86	
Fuel	2,633 60	
Supplies	1,506 26	
	$10,766 72	
Less received for transportation	438 13	
		10,328 59
Stamp Mill Expenses.		
Labor	$29,415 72	
Fuel	39,495 74	
Supplies	9,546 08	
Fire insurance	950 00	
Teaming, mineral, etc.	748 22	
		80,155 76
Total working expenses		$340,045 78

CONSTRUCTION ACCOUNT.

At Mine.

Moving No. 2 engine House, materials used in equipping No. 2 hoist, and No. 2 shaft balance road, rails, etc.		$6,335 00	
One fire-box boiler	$1,333 00		
Addition to boiler-house, labor, etc	1,742 00		
		3,075 00	
One side duplex compressor	$2,000 00		
Labor and materials used for same	575 00		
		2,575 00	
One 17x24-inch rock breaker	1,450 00		
Labor and materials used for same	150 00		
		1,600 00	
One 24-foot "E. B." planer	$345 00		
Labor and addition to carpenter shop	205 00		
		550 00	
Fixtures for heating office with steam		300 00	
Additions to dwelling houses		855 00	
			15,290 00
At Mill.			
One new boiler		$1,725 00	
Addition to boiler house, labor, etc.		889 51	
One log dwelling		184 79	
Additions to dwellings		425 00	
			3,224 30
At Dock.			
Materials for new dock			1,851 73
Exploring on Section 16.			
Labor		$1,401 87	
Supplies		28 50	
			1,430 37
Total expenditure			$361,842 18

SUMMARY OF RESULTS.

Ground broken in openings and stopes	16,844 152-216 cubic fathoms.
Rock stamped	298 tons
Product of mineral	5,383,910 lbs
Product of refined copper	3,974,972 lbs
Yield of refined copper per cubic fathom of ground broken	236 lbs
Yield of rock treated, 13,336 lbs. copper per ton, or	0.667 per cent
Gross value of product, per ton of rock treated	$1.9718
Cost per ton of mining, selecting and breaking, and all surface expenses, including taxes	.8373
Cost per ton of transportation to mill	.0347
Cost per ton of stamping and separating	.2689
Cost per ton of working expenses at mine	1.1409
Cost per ton of freight, smelting and marketing product, including New York office expenses	.2142
Cost per ton of running expenses	1.3551
Total expenditure per ton of rock treated	1.4282
Net profit per ton of rock treated (exclusive of interest earned)	.5436

AGENT'S REPORT.

Atlantic Mine, L. S., Mich., January 1, 1889.

JOHN STANTON, ESQ, *Treasurer Atlantic Mining Co., New York.*

Dear Sir—I herewith present the following report of operations at Atlantic mine for the year 1888:

There has been a falling off in the yield of the rock during the last six months. We have experienced the same before, but only for periods of one or two months. The difference is so small that it cannot be detected in the mine, nor by inspection of the rock on surface, but I believe that the rock in the vicinity of No. 1 shaft in the upper levels is leaner than that in the other parts of the mine.

No. 1 shaft has been put in operation down to the 7th level. We have been drifting and stoping in the 2d, 3d, 5th and 7th levels north and south, but have abandoned the 2d and 3d levels in order to ascertain if the yield of the rock will not be better in the lower levels.

No. 2 shaft has been extended to the 12th level, and the openings have been continued in the 8th, 10th and 11th levels north, with fair results. The 8th and 10th levels have been extended beyond No. 1 shaft, and we are rising to connect No. 1 shaft with the 8th level.

No. 3 shaft has been sunk from the 17th to the 18th levels, and drifting and stoping have been done in the 14th, 15th, 16th, 17th and 18th levels north, and in the 16th, 17th and 18th levels south. In the vicinity of No. 3 shaft we find our most productive ground.

No. 4 shaft has been put in working order from the 15th to the 16th levels, and we have continued drifting and stoping in the 11th, 12th, 13th, 14th, 15th and 16th levels, leaving pillars and arches for protection, as the hanging wall is very poor in the southern part of the mine.

It will be necessary to extend No. 1 and No. 2 shafts to the lower levels as fast as possible. The shafts, pump, skip-roads and railroads are all in very good working order.

SURFACE.

Everything has worked satisfactorily on surface, but some changes have been made. The 30-lb. rails have been removed from the trestle track and 50-lb rails substituted for

them. We have put in the necessary driving sheaves to use ½-inch wire rope on the trestle cars in place of the manilla rope. The road now runs very satisfactorily.

The large "Blake breakes" in the rock-house has been altered, so that the rock is crushed directly to a size suitable for the stamps, which is more economical than the use of two breakers of different sizes.

RAILROAD.

The railroad has been run cheaply during the past year, although the rolling stock and also the road have been kept in very good condition.

We have made eight trips per day to the mill, each trip taking 24 cars of five tons each capacity.

STAMPING.

Nothing of importance has been done at the mill. It has been operated very economically, and it is in very good condition.

There have been many repairs to the launders which carry water to the mill. A new bridge has been erected, and portions of the launders have been renewed.

It also became necessary to build a new dock to properly care for our coal and freight. This is now under way and will be completed before the spring.

CONSTRUCTION.

The hoisting machinary at No. 1 shaft has worked so well with the counter-weight arrangement, that we have altered No. 2 engine so as to work in the same way. We moved the engine house from the old stand to a spot 300 feet east of No. 2 shaft, built a new hoisting drum 12 feet in diameter, and a drum for the counter-weight of 11 feet diameter.

A new railroad in No. 2 shaft has also been built with 20-lb. T-rails, upon which the counter-weight runs, the weight of which is about the same as the skip in addition to one-half the weight of the rock.

In 1885 we purchased of S. E. Cleves & Son one-half of a duplex compressor 16½ x 30 inches. This year we have bought the other half, and it is working very satisfactorily.

It became necessary to add to the boiler plant that furnishes steam for the pump and compressors. We therefore purchased and put in place a large tubular boiler. For this we made an addition to the old boiler house 32x25 feet, which is built of stone and covered with a slate roof.

The present plant will furnish the necessary power for years to come.

To the rock-house machinery we have added one 17x24 inch "Blake Breaker," which crushes the rock directly to a size suitable for the stamps.

An addition has been made to the carpenter shop 16x18 feet, in which we have placed a planer.

There have been five additions made to dwelling houses.

At the stamp mill there has been added to the boiler plant one new tubular boiler, and to the boiler house an additional 16x60 feet. We have now ample steam capacity for the amount of rock we are treating.

In closing, I would refer you to the tables prepared by Mr. H. M. Rickard, showing the costs in the various departments, and to the maps filled out to date by Mr. F. McM. Stanton, showing the ground broken in the mine during the past year. The work has been carried on very smoothly during the year by my assistants, who have worked faithfully for the interests of the company.

Yours truly,

WM. TONKIN, *Agent.*

The following table gives the product each year:

Year.	Tons.	Pounds.	Year.	Tons.	Pounds.
1866	6	1,475	1878	1,132	1,592
1867		1,760	1879	1,152	1,822
1868	764	258	1880	1,170	1,195
1869	823	857	1881	1,264	9
1870	186	617	1882	1,315	1,708
1871			1883	1,341	197
1872			1884	1,586	1,585
1873	431	1,336	1885	1,791	533
1874	686	403	1886	1,751	1,670
1875	783	1,036	1887	1,820	1,865
1876	917	1,041	1888	1,987	972
1877	1,027	304			
Total				21,939	268

It will be seen that the product of 1888 was the largest in the history of the mine. The mine is no richer, only more rock was stamped.

Since the foregoing was written the announcement is made that Capt. Wm. Tonkin, who for so many years has been at the mine as mining captain and agent, has resigned, and Mr. Frank Stanton succeeds him.

THE HURON COPPER CO.

The Huron mine seems to me to be in better shape than ever before. Of course it must be classed among those mines that require favorable conditions in order to be worked successfully. It cannot be said that the conditions have been very favorable with the Huron except in the matter of management. It is very economically and skillfully managed, and this fact has enabled the company to surmount some embarrassing difficulties in recent years, in addition to the discouraging state of the copper market.

If it were a rich mine, yielding a larger percentage of copper to the fathom of ground opened, there would be no difficulty in overcoming the misfortunes that have been met with. But the average value of the lode is low—it must be extensively opened to find a sufficient amount of paying ground to stope. The machinery and buildings are old fashioned, but they have been repaired and remodeled so that they are as effective and as good as new. All the changes and improvements have been gradually made, as the circumstances of the company would permit, except in the case of reconstructing the dam,

when it broke away, rebuilding the stamp mill after the fire, and the purchase of new boilers to replace the one destroyed by explosion and to meet the increased demands for power. These expenditures had to be met, forthwith, *nolens volens*. But otherwise all improvements have been made so gradually as to be scarcely perceptible at the time, and yet one sees now that there has been great change for the better at the Huron. Everything is working nicely and under the stimulus of higher prices for copper the location has a smiling, prosperous look.

The mill, especially, impresses one favorably; no stamp heads work better with a uniform pound of 96 strokes per minute. Capt. Vivian has recently placed long timbers under the mortars to receive the blows, and finds that it has served to increase the effectiveness. He estimated that this change would add 20 tons per day to the amount crushed. He hoped to stamp 11,000 tons per month—27 days. Whether he has succeeded in accomplishing this result or not I do not know. The superintendent of the mill is Mr. William Vivian. There are four slime tables in the wash-house, each 15 feet diameter, and the fifth one is nearly ready to operate. Its place is near the roof, above the others, and will be used for finishing.

The following are summaries of the year's work.

Mining Expense, Labor, etc., Account and Cost.

No. of Men.	Mining Capt., Timbermen.	Miners on Day account.	Machinists, Engineers, Firemen.	Blacksmiths, Carpenters and Mining engineers.	Trammers and Laborers.	Total.
139	$9,276 55	$1,074 07	$7,634 46	$3,461 54	$33,939 82	$55,386 44

Statement of Shafts and Winzes Sunk and Cost of Same.

No. Men.	No. of Feet Sunk.		Average Price per Foot, Sinking.		Total amount paid for sinking Shafts.	Total amount paid for sinking Winzes.	Total.
	Shafts.	Winzes.	Shafts.	Winzes.			
8⅓	338 2-10	244 2-10	$17 24	$15 13	$5,333 08	$3,697 35	$9,030 43

Mining Expenses, Drifting, Cross-cutting, and Cost of Same.

No. Men.	No. of Feet Drifted.	Av. price paid per foot.	No. feet of Cross-cuts.	Av. price paid per foot, Cross-cut.	Total for Drifting.	Total for Cross-cutting.	Total Expense.
26⅓	2,618 5-10	$8 84	188	$9 00	$23,149 13	$1,692 62	$24,841 75

Stoping and Cost of Same.

Number Men.	No. fathoms stoped.	Average price per fathom.	Amount paid for stoping.	Total.
79⅛	7,868 50	$9.24	$73,471 91	

Sundry Labor, Mining Expense Account.			*Supplies, Fuel, Etc., and Cost of Same.*				
No. Men.	Special Contracts.	Total.	Supplies.	Wood, coal, teaming.	Total	Less profit on supplies charged to miners, transportation, hospital, etc.	Net total.
1	$115 65	$115 65	$8,706 90	$31,297 87	$40,004 77	$21,067 68	$18,937 09

Recapitulation of Mining Expenses.

No. Men.	Co. Account. Labor.	Sinking Shafts and Winzes.	Drifting, Cross-cutting.	Stoping.	Sundry Labor.	Supplies and Fuel.	Total.
	$55,386 44	$9,030 43	$24,841 75	$73,470 91	$115 65	$18,937 09	$181,782 27

Rock House Account.—No. Men, Etc.

No. Men, Co. Acct.	No. of Men, Contract.	Total No. of Men.	Tons hoisted to surface.	Tons dumped in mine.	Total tons of rock hoisted.	Tons rejected.	Tons sent to rock-mill.
109⅛	114⅛	224	1,545.04	895	155,399	44,719	110,680

Locality of Mining Contracts, i. e., No. 7 Level in which Work was Done and Amount of Work Done in Each.

Level	4	5	9	13	14	15	16	17	18	Total.
Feet drifted	81	------	-----	--------	251	492.4	673.1	1,073.1	835	2,618.5
Fathoms stoped	5	35.5	52	532.5	1,505.625	2,010.5	2,252.75	1,435.25	393.75	7,868.5
No. feet of cross-cut	------	------	------	--------	----------	60.25	43.4	41	43.5	188
Winzes sunk	------	------	-----	52.3	110	82	----------	----------	----------	244.3
Shafts sunk	------	------	------	--------	----------	----------	121.5	201.7	15	338.2

Surface Expense, Labor, Supplies, and Cost of Same.

No. Men.	Wages.	Teaming, Supplies, Wood.	Wagons, Sleighs, Harness and other repairs.	Total.	Taxes, house rent and other charges.	Net total.
20.5	$10,187 76	$2,379 84	$621 88	$13,189 48	$3,229 91	$9,959 57

Stamp Mill Expense. 2 Heads.

No. of Men.	No. Cords Wood and Tons Coal.		Cost of Fuel.		Cost of Foundry Bills.	Cost of other supplies.	Cost of Labor.	Total Cost
	Coal.	Wood.	Coal.	Wood.				
	tons. lbs.	cords.						
	2,504 1890	7,157	$10,657 18	$21,471 00	$1,803 25	$4,205 03	$13,964 45	$52,082 97

Statement Showing Results of Stamping.

No. of Days Run.	Tons Stamped.	Per Cent per Ton.	Pounds of Copper Produced.	Tons Stamped per Cord of Wood.	Cost of Stamping 1 Ton of Rock.
11,351¾	110,680	131	28,928.40	10.13	47.05 cents.

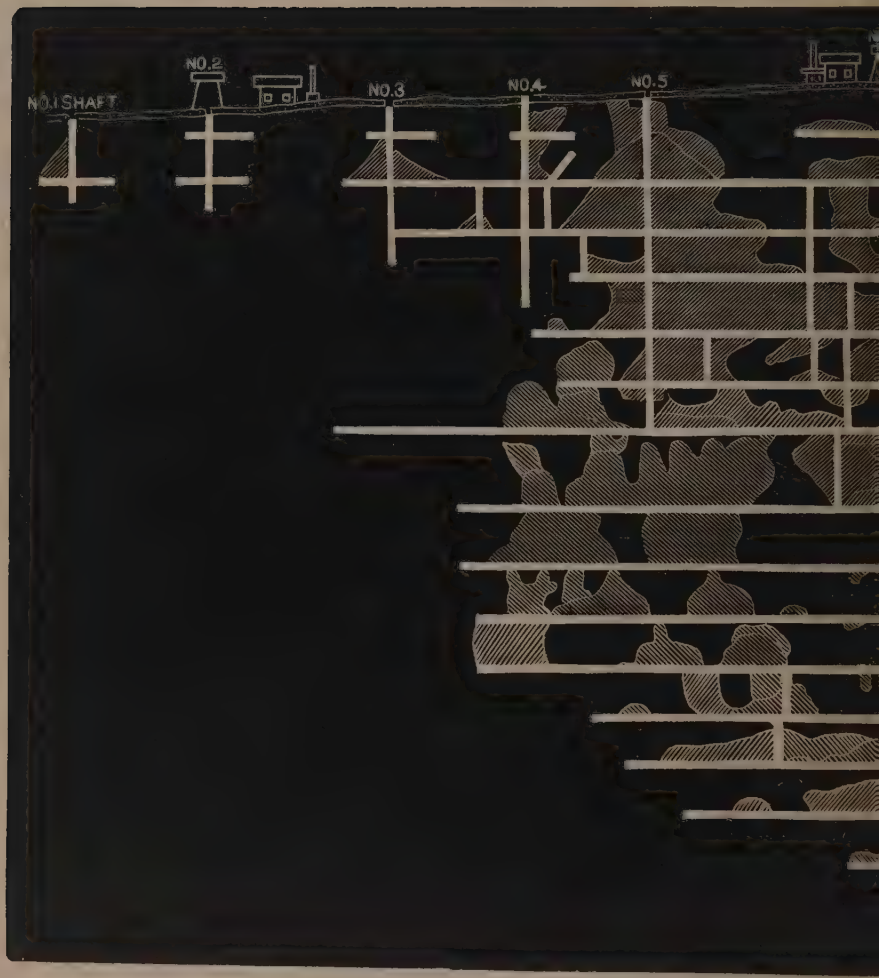
The following table of yearly products shows that this mine yielded more in 1888 than in any previous year.

Year.	Tons.	Pounds.	Year.	Tons.	Pounds.
1855	3		1872	276	1,684
1856	12		1873	237	1,883
1857	35		1874	125	1,005
1858	24		1875	31	1,289
1559	22	1,387	1876	31	1,857
1860	4	1,000	1877	41	161
1861	49		1878	32	1,100
1862	69	1,305	1879	14	1,760
1863	69	206	1880	35	285
1864	50	1,745	1881	127	515
1865	238	11	1882	182	579
1866			1883	360	213
1867	683	1,164	1884	963	1,660
1868	740	80	1885	1,135	1,163
1869	841	863	1886	946	995
1870	42	183	1887	742	103
1871	134	1,453	1888	1,187	1,147
Total				9,542	806

D. L. Demmon, Secretary and Treasurer, 19 Congress street, Boston, Mass.; Johnson Vivian, Superintendent, Hancock, Mich.; T. Whittle, Mining Captain; Alex. Loranger, Clerk.

LONGITUDINAL SECTION

Scale : 300



THE HURON MINE, 1889.

an inch.

LONGITUDINAL SECTION OF THE ISLE ROYAL MINE, 1889.

Scale: 300 feet to an inch.

The Huron is the most southerly of a group of mines situated south of Portage Lake in the village of Houghton and opened in the Isle Royal lode. Its experience is of value to the companies north of it, between it and the lake.

Passing the Isle Royal, Grande Portage and Sheldon Columbian mines, which remain idle, and for descriptions of which reference is made to previous reports, we cross Portage Lake to the north side and come directly to the

QUINCY MINE,

which until recently ranked only second among the copper mines of the State, but has had to assume the position of third in rank, not through any falling off in the richness of the mine or in the annual profits of working, but simply from the fact that a new mine has come in to displace it from its time-honored place. The Quincy is as good as ever it was, but no amygdaloid deposit has yet been found that can vie with the Calumet & Hecla conglomerate in richness, and so the Tamarack leads it. The Quincy people are prepared to build a new stamp mill, which is all that is needed, I think, to put the mine abreast with the times. The old mill is obsolete. There is no sort of doubt but that the present mill greatly hampers the working of the mine, and increases the cost of the production. The amount of rock broken annually is limited to the capacity of the mill. The mill is made to do all it can, but the maximum of its work is away below the capacity of the mine to produce. The result is that there is left standing much good ground in the mine that is lower grade than that which is mined and treated. If the Quincy had a mill corresponding with those of other prominent mines, it is probable that the percentage of the rock treated would not be as high as it is, for the reason that far more of it would be stamped, and a portion of it much leaner than that now treated. The location for the new mill is a good one—on lot 3, Sec. 23, T. 55, R. 33. The company owns the land on both sides of the lake, at this end. They have built a dock 200′x32′, and have much other preliminary work done at the site. They have contracted for a Worthington pump, capacity, 8,000,000 gallons; Corliss engine 14″x36″—6 steel boilers, each 6′x16′, return tubular. The railroad from mine to mill, called the Quincy & Torch Lake, is six miles long, 3-ft. gauge, and an almost uniform grade of 80 feet to the mile, with no sharp curves. The grading, etc., is about completed, except for the space of 3,000 feet across the Franklin & Pewabic properties.

The vertical depth of the mine is 2,240 feet, or 2,980 feet on the inclination of 52°. They are straightening No. 4 shaft. It is fish-bellied—that is from the 60th level to the 180th, the line of the shaft is the arc of a circle,

concave upward; in future, when completed, the track will follow the chord of the arc, and thus will be a great improvement in this important shaft. The work is proceeding at several points, which must finally align accurately. Messrs. Emerson & Bailey do the engineering, and there will be no difficulty as to the outcome of the work. The maximum ver-sine of the curve of the line of the old shaft is 42 feet—that is, the greatest distance from the old shaft to the line of the new one.

The map of the mine is marked up, and that, with the published report of the company give all the facts that are of interest.

The company has paid 40 dividends amounting to an aggregate of $4,970,000. The two paid in 1888 equal $360,000, and a further dividend paid in July, 1889, will bring the total up to $400,000.

Quincy Mine Report.

The directors submit the following report of the business of the mine for the past year, and statement of the financial condition of the company.

The product of the mine was 7,762,945 pounds, or 3,881 945-2000 tons of mineral, yielding about 83 3-10 per cent, or 6,367,809 pounds of refined copper, for which has been realized the gross sum of		$1,014,315 38
Realized from sale of silver		4,173 04
		$1,018,488 42
The expenses of the year are as follows:		
Running expenses at mine	$360,485 39	
Building and construction account	33,433 01	
Quincy & Torch Lake Railroad	67,117 37	
Machinery contracted for	75,000 00	
Smelting, transportation and all other expenses	106,841 84	
		$642,977 61
Leaving as mining profit		$375,510 81
There has also been realized during the year, from interest on loans		10,245 85
Received from real estate, Hancock		500 00
Making the income of the year		$386,256 66

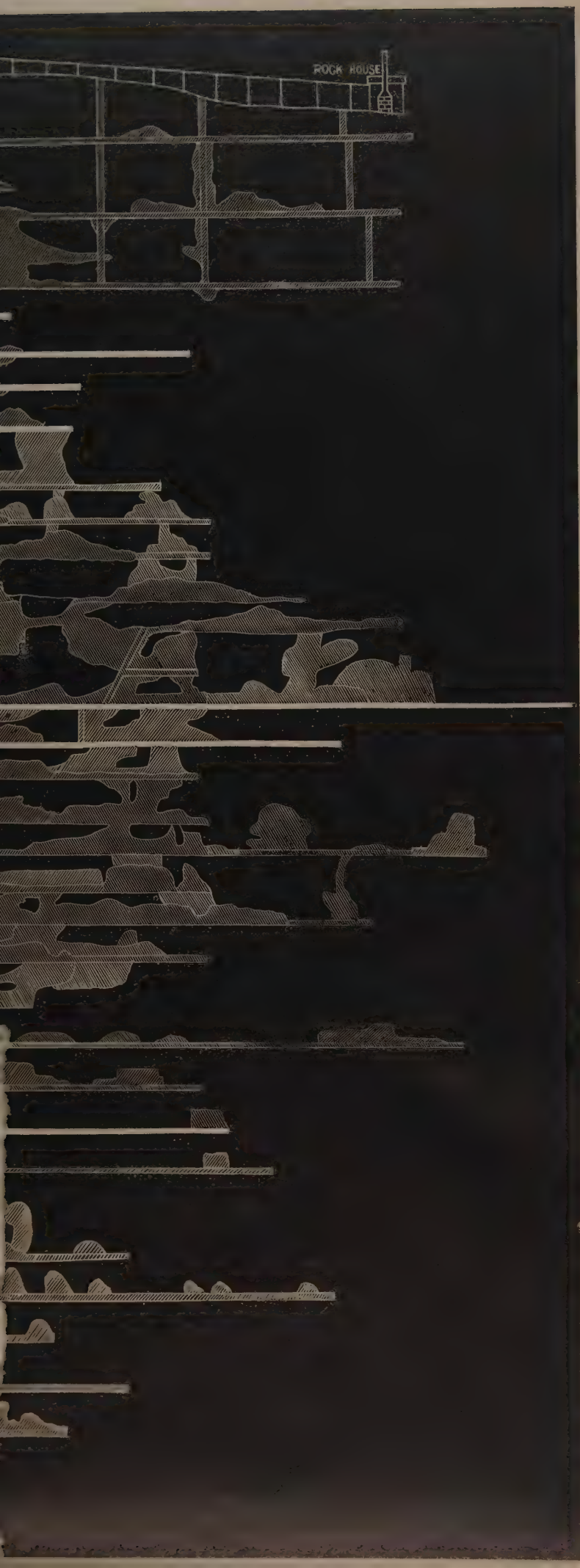
The statement of assets and liabilities in our last report showed a balance on hand, as of date:

January 1, 1888		$536,509 75
Add earnings of 1888		386,256 66
		$922,766 41
Deduct dividend of February 15, 1888	$160,000 00	
Deduct dividend of August 15, 1888	200,000 00	
		360,000 00
Leaving balance of assets Jan. 1, 1889		$562,766 41

A dividend of $5.00 per share, or $200,000, payable February 15, has been declared, which, with dividend of $5.00 per share, paid August 15 last, makes total for the year $400,000.

LONGITUDINAL SECTION OF THE QUINCY MINE, JAN., 1889.

Scale: 300 feet to an inch.


ROCK HOUSE

The usual financial statements are submitted, and also the report of the agent, which states clearly the present condition of our property.

THOMAS F. MASON, *President.*

New York, February 15, 1889.

GENERAL SUMMARY OF RECEIPTS AND EXPENDITURES OF THE QUINCY MINING COMPANY, FROM ITS ORGANIZATION TO DECEMBER 31, 1888.

Receipts.

From capital stock paid in	$200,000 00
From proceeds copper and silver (10,221,448 lbs. copper)	19,262,774 83
From interest	136,512 31
From profit on sale P. L. & R. Improvement company stock, and other investments	79,637 16
From sales of real estate, Hancock, Mich.,	58,450 43
	$19,677,374 73

Expenditures.

For expenditure on location previous to 1856	$42,097 98
For expenditures on Quincy vein, 1858, not now worked	55,000 00
For openings and explorations on 3,800 feet "east" or Pewabic vein, extending to Portage Lake, preparatory to future work	11,500 00
For real estate and permanent improvements on same, including dwelling houses, stamp mill, machinery, steam engines, railroad, dock, warehouse, and other buildings and roads	1,193,698 05
For mining and surface labor, expenses of smelting and marketing copper, and all incidental expenses	12,842,312 29
Balance carried down	5,532,766 41
	$19,677,374 73
By balance brought down, being receipts over expenditures	5,532,766 41
Deducting dividends declared, Nos. 1 to 40 inclusive	4,970,000 00
Leaving balance as per statement below	$562,706 41

STATEMENT OF ASSETS AND LIABILITIES EXCLUSIVE OF REAL ESTATE, MINE PLANT AND SUPPLIES IN USE, JANUARY 1, 1889.

Assets.

Cash at New York office, and copper	$579,045 73
Cash on hand at mine	6,902 24
Accounts receivable, since paid	33,035 00
	$618,982 97

Liabilities.

Drafts unpaid	$1,104 85	
Dividends unpaid	440 00	
Accounts payable in New York	13,475 00	
Accounts payable at mine	115,056 62	
		130,076 47
		$488,906 50
Add at mine, viz:		
Supplies per inventory on file	$61,182 67	
Farm account (horses, wagons, etc.,	11,895 93	
Accounts receivable	781 31	
		73,859 91
		$562,766 41

Less dividend payable February 15, 1889, $5.00 per share, $200,000.

SUMMARY FOR YEAR.

Average force employed		471 men
" number of miners		158 men
" wages of miners on contract, per month		$49 60
Yield of mineral per fathom of ground broken		842 lbs.
Yield of refined copper per fathom of ground broken		690 lbs.
Total rock mined		165,978 tons
Total rock hoisted		123,376 tons
Total stamp rock treated		117,514 tons
Yield of rock stamped		3.04 per cent. mineral
Product stamp mineral	7,141,570 lbs.	
Product masses	621,375 lbs.	7,762,945 lbs.
Product refined copper		6,367,809 lbs.

AGENT'S REPORT.

QUINCY MINE, LAKE SUPERIOR, MICH., *January 31, 1889.*

During the year No. 2 shaft was sunk from the 37th to the 38th level. It passed through several bunches of mixed vein matter, and the last twelve feet was entirely in good copper ground.

The drifting done from this shaft was at the 37th, 36th, and 35th levels north. The 38th level was extended north from shaft a few feet only, but was driven south and connected with the drift from No. 4 shaft.

No particular change has been noticeable during the year as to the general character or quality of the vein in the new openings.

The first 160 feet to 180 feet of drifting in both the 36th and 37th levels was in very good copper ground, but the vein, for the remainder of the drifting was more bunchy and less productive. The 35th level showed only a narrow, low-grade vein. The 38th level was mostly in vein of full average quality.

The principal stoping done in this part of the mine was at the 37th and 36th levels north and south of shaft; and at the 35th level north of shaft. Some profitable stoping was also done at the 34th and 33d levels north and south, and at the 31st, 30th 29th and 28th levels north of shaft.

During the year No. 4 shaft was sunk from the 37th to the 38th level. It showed bunches of good stamp rock now and then, but the main copper-bearing vein is still east of it, and is reached by a cross-cut, as formerly.

The drifting done from this shaft was at the 38th level, north, connecting it with No. 2 shaft, and at the 37th, 36th, 35th and 33d levels south of shaft. The vein shown in the drift at the 38th level is rather narrow, but has short bunches of very rich rock. The drifts at both the 37th and 36th levels are mostly in good vein. The 35th level showed short bunches of very good vein, the drifting on the whole being in vein of fair average quality. The drifting at the 33d level was mostly in a narrow low-grade vein.

The principal stoping done in this part of the mine was at the 34th and 35th levels south, and at the 36th and 37th levels north and south of shaft. A little profitable stoping was also done at the 25th, 26th, 32d and 33d levels, south of shaft.

At the 38th level, just north of No. 4 shaft, a cross-cut was driven east 35 feet, when it intersected a vein carrying a medium quality of stamp copper for about 14 feet in width. Only a few feet of drifting, and but little stoping was done there. No other stoping than this was done at the 38th level.

In sinking No. 4. shaft, a great many years ago, it was allowed, somehow, to make a bow-shaped bend between the 9th and 17th levels, causing the shaft at the 13th level to warp back in the foot-wall side about 50 feet from its proper angle or slope. It became necessary, therefore, to straighten the shaft between those points, and the work is now being carried on without interfering at all with the rest of the regular mine work. This new work is being done in sections, by cross-cutting at different levels, and then by sinking and rising to make connections. Between the 16th and 15th levels an apparently large body of vein, rich in mass and barrel copper, was discovered. This will become available as soon as the new shaft work is completed. During the year the man-engine shaft was extended and put in working order from the 31st to the 33d level. In sinking this shaft between the 32d and 33d levels a block of very rich vein was met with, and so much of it taken out that stoping can be resumed there at any time without interfering with the shaft.

The diamond drill was not used much during the year. A few holes only were bored at the 36th level north and south of No. 2 shaft, but nothing of value was discovered.

There was not much extra work, or any extensive changes made around the mine during the past year. The most important improvement was the renewal of the man-engine gear and its foundations. The old gear having become worn out and unsafe, was replaced by a new and stronger one consisting of an 18-foot diameter "step gear" wheel a 22-inch pinion, and a 14-foot 12-inch shaft. This machinery now works very satisfactorily.

A large stone and cement cistersn 20x20x10 was built back of the hospital to supply the dwelling houses in that vicinity with water, and to serve as an additional safeguard in case of fire in that quarter.

Some further expenditures were incurred at the new rock house, by way of finishing it, which makes it now very complete in all its parts.

The usual repairs to machinery, to dwelling houses and other buildings were made, and everything about the mine kept in good working order.

The old mill did excellent service last year in stamping 117,514 tons of rock, which is the best year's duty it ever performed.

Preparations for building the new stamp mill at Torch Lake were made as early in the season as circumstances permitted. Work was begun there in the month of August, and continued until the bad fall weather set in. During that time there was built a boarding house, which is designed for future use as a blacksmith, carpenter and cooper shop; a dock 200x32 feet, with an approach in the center 160x32 feet; an adit or watercourse 5½x6 feet, and 6 feet below lake level, was made from the lake to the site for the pump house, a distance altogether of about 600 feet. At the end of the adit a stone cement cistern or well, 50x7x17 feet was built. The boiler house and pump house were located and their foundations partly made. The excavation for stamp mill building which will be 120x200 feet, was made, and most of the stone foundations for the walls of building finished. Work will be resumed there as early in the spring as the weather permits. Most of the principal equipment for stamp mill plant has been contracted for, viz.: Two steam stamps of latest improved design, capacity of each at least 250 tons of rock per 24 hours. (A third stamp will be added later.) An 8,000,000 high duty pumping engine; one 14″x36″ Corliss engine; six 6′x6′ return tubular boilers; fifty-six iron jigs; timber, lumber, lumber, etc.

The stamp rock will be transported from the mine to the mill over the Quincy & Torch

Lake Railroad, which is now in course of construction, and is expected to be completed and in running order early this coming summer.

The road was duly organized in June last, under the laws of the State of Michigan. The surveyed line extends from the Quincy mine to a point beyond the new Quincy stamp mill, near the shore of Torch Lake, in Section 23, T. 55, R. 33. The road will have a gauge of three feet, and be about six miles in length, with an almost uniform grade of eighty feet to the mile. With the exception of a gap of about 3,000 feet (across the Pewabic and Franklin Mining companies property) the road is graded and most of the culverts built. Seven bridges will be required, the timber for which has been contracted for. The railroad iron and ties are on the ground ready for use, and track laying will commence in the spring as early as possible.

There are now being built for this road two 50-feet iron turn tables, one 32-ton mogul locomotive, four 28-feet flat cars, and one caboose, all of which will be shipped there by rail before navigation opens. The required number of 12-ton rock cars, another locomotive, and other equipment will be ordered later on, as needed.

Maps of the mine and tabulated statements of work and expense in the different departments, have as usual been sent from this office.

All of which is respectfully submitted.

S. B. HARRIS, *Agent.*

The quality of the rock that is stamped varies but little in richness. This is shown by the percentage of copper obtained, as given in the following table:

Year.	Per Cent.	Year.	Per Cent.	Year.	Per Cent.
1861	2.55	1870	2.61	1879	1.80
1862	2.03	1871	2.29	1880	2.50
1863	2.75	1872	2.17	1881	2 88
1864	2.96	1873	2.60	1882	2.80
1865	2.60	1874	2.61	1883	2.85
1866	2.63	1875	2.44	1884	------
1867	2.74	1876	2.38	1885	2.70
1868	2.25	1877	2.11	1886	2.70
1869	2.48	1878	1.76	1887	2.97
				1888	3.04

Table showing yearly product of Quincy mine.

Year.	Tons.	Pounds.	Year.	Tons.	Pounds.
1856	6	1,462	1873	1,400	
1857	61	762	1874	1,525	654
1858	153	772	1875	1,334	281
1859	178	1,114	1876	1,536	1,171
1860	970	414	1877	1,427	336
1861	1,218	852	1878	1,480	449
1862	1,153	218	1879	1,323	1,458
1863	1,115	1,737	1880	1,848	263
1864	1,251	586	1881	2,753	884
1865	923	1,500	1882	2,832	1,796
1866	1,172	1,000	1883	3,006	239
1867	1,013	1,000	1884	2,825	436
1868	727	1,000	1885	2,924	497
1869	1,208	1,365	1886	2,961	1,529
1870	1,248	1,777	1887	2,804	1,762
1871	1,204	1,501	1888	3,183	1,889
1872	1,334	1,134			
Total				50,047	1,702

PEWABIC MINE.

Of this mine there is nothing to be said. A decision was recently reached in the Supreme Court of the State adverse to the possibility of the existence of the company as a corporation. It seems that the mine must be ultimately sold, and probably both the Quincy and Franklin companies desire to own it. It would be valuable for either, and could be so divided as to be of great advantage to both.

THE FRANKLIN MINING CO.

has also had a prosperous year, having paid a dividend of $160,000. Its more recent prosperity is in strong contrast to its record of failure in former years. I am always well pleased to go about the Franklin location; it is a little old fashioned, may be (the machinery), but everything is orderly and the work is rapidly and economically done.

A Worthington steam pump 16x4x10 takes the water now from the lake, at the mill, to the mine, 7,000 feet distant. Also at the mill have a sand wheel 35 feet in diameter, which works very finely. It elevates the water

and sand from the wash-house into a launder that carries it a long distance away.

The mine has grown deeper rapidly, and to meet the increased demand for power, three new boilers have been added, and a fourth may also be required.

The rock is gathered from the three shafts into the bins over the railroad track, and the cars are filled very handily. I think that the arrangements for handling the rock are economical.

No. 2 shaft is at the bottom, to the 29th level—that is to the company's line, underground.

No. 3 to the 31st level, and No. 5 to the 30th.

No. 3 to No. 5 is 600 feet. The former can still be deepened two levels before the limit is reached.

No. 5 has been sunk from the 28th down, but not much has been done otherwise. The extreme distance that the mine is opened north of No. 5 is 550 feet in the 23d to 27th levels, thence to 30th the length of levels north of the shaft is 500 feet.

At the bottom, No. 2 is 300 feet from No. 3. No. 5 is 600 feet. The line of intersection of the lode with the limits of the property, inclines downward at about 50 degrees with the horizon.

I have much interesting detail of the work at Franklin mine in addition to what is given in the published report of the company.

Mining Expenses, Labor and Cost of same—1888.

No. of men.	Mining captains and timbermen.	Miners on day account.	Machinists and firemen.	Blacksmiths and carpenters.	Trammers and laborers.	Total.
131	$13,689 22	$1,933 02	$13,602 55	$3,338 64	$35,504 80	$68,068 23

Statement of Shafts and Winzes Sunk and Cost.

1888.	No. of men.	No. of feet sunk.		Average price per foot.		Amount paid for shaft sinking.	Amount paid for sinking winzes.	Total.
		Shafts.	Winzes.	Shafts.	Winzes.			
Average for year.	8½	364 1-10	80	17	$12 81	$6,192 56	$1,025 20	$7,227 76

Drifting, Cross-cutting and Cost of Same.

1888.	No. men.	No of feet drifted.	Av. price per foot.	No. feet cross-cutting.	Av. price per foot.	Am't paid for drifting.	Am't paid for cross-cutting.	Total.
Average for year.	27	2,290 2-10	$9 61	----------	----------	$28,742 43	----------	$28,742 43

Stoping, and Cost of Same.

1888.	No. of men.	No. of fathoms stoped.	Av. price paid for stoping.	Amount paid for stoping.	Total.
Average.	94	8,649 510-1000	$10 37	$89,731 81	$89,731 81

Statement Sundry Labor and Cost of Same.

Special contracts.	Extra labor, aside from contracts.	Man engine.	Surveys and maps.	Boiler repairs.	Total.
$90 00	$1,246 86	$4,439 34	$196 01	$1,264 88	$7,237 01

Statement of Supplies, Fuel, Etc., and Cost of Same.

1888.	Supplies.	Wood, coal and teaming.	Use of diamond drill, pd. Huron Co	Total.	Less profits on supplies.	Total.
Average for year.	$16,071 27	$29,288 77	$200 00	$45,560 04	$18,526 65	$27,033 39

Recapitulation of Mining Cost.

Co. Account. Labor.	Sinking shafts.	Drifting and cross-cutting.	Stoping.	Sundry labor.	Supplies and fuel.	Total.
$68,069 23	$7,117 76	$28,742 43	$89,731 81	$7,237 09	$27,033 39	$228,030 71

Rock Account, Men, Etc.

No. of men on Co. Account.	No. of men on contract.	Total No. of men.	Tons of rock hoisted.	Total tons rejected.	Tons of rock sent to mill.	Per cent of rock rejected
130	129	259	181,451	39,950	141,501	21

Statement of Labor and Supplies, and Cost of Same. Surface Expense.

No. of men.	Wages.	Teaming and supplies.	Wagons, sleighs, harness and other repairs.	Total.	Less house rent and supplies.	Net total.
37	$17,907 85	$4,663 25	$426 14	$22,985 29	$9,358 83	$13,625 46

Stamp Mill Expense, 4 Heads.

No. men.	No. cords wood.	Cost of wood.	Cost foundry bills.	Cost of other supplies.	Cost of labor.	Total.
57	9,528¼	$27,594 37	$2,295 46	$4,099 11	$22,454 48	$56,443 42

Statement Showing Results of Stamping.

No. days run.	Tons stamped.	Cost per ton.	Lbs. copper produced.	Tons stamped per cord of wood.	Cost of stamping one ton of rock.—Cents.
21½	141,500	$1 07	3,038,457	14.85	39 81

Excess of smelter weight over mine weight, 8,812 lbs.

Tram Road Expense, Cost of Running to Mill, Tons Delivered.

No. men.	Cost of labor.	Cost of fuel and supplies.	Total cost.	No. tons run over the road.	Cost per ton.
14½	$6,928 85	$1,555 96	$8,484 81	41,501	5.99 Cents.

Rock House Expenses, Cost of Breaking and Delivering Rock into Cars.

No. men.	Cost of labor.	Cost of supplies.	Total cost.	No. tons of rock.	Cost of breaking and delivering.	Cost per ton of rock hoisted.
39	$16,276 81	$423 11	$16,699 92	141,501	11.80 cents.	9.2 cents.

General Expenses, Insurance, Taxes, Agency, Etc.

No. men.	Agent and watchman.	Insurance.	Taxes.	Attorneys and discounts.	Electric lights.	Totals.
2	$4,599 96	$2,227 62	$2,837 11	$640 22	$98 00	$10,452 91

Office Expense.

No. men.	Checks.	Fuel, oil.	Stationery, telegraphing.	Total.	Credit, commissions.	Total.
2	$2,280 00	$85 75	$612 12	$2,986 87	$333 72	$2,653 15

Construction, Repair Expense.

Sand wheel.	Coal dock.	New boiler.	Total.
$4,722 41	$263 43	$1,000 00	$5,985 84

No. men.	Mining ex.	Surface expense.	Stamp mill expense.	Tram road expense.	Rock house expense.	General expense.	Office expense.	Construction repairs, expense.	Total.
411	$228,030 71	$13,626 46	$56,443 42	$8,484 81	$16,699 92	$10,452 91	$2,653 15	$5,985 84	$342,377 22

Stamp mill copper, total mineral.	Mass and barrel copper, mineral.	Total amount of copper.	Per cent.	Total ingot.	Cost of mineral per lb. at smelting works.
30,384 57	1,399,145	4,437,602	82,38	3,655,751	7.71 cents.

Cost ingot per pound, 9.36 cents.

Per cent ingot in rock stamped.	Per cent of mineral in rock stamped.	Lbs. ingot in ton of rock stamped.	Lbs. mineral in ton of rock stamped.	Per cent of ingot in ton rock hoisted.	Per cent mineral in ton rock hoisted.	Lbs. ingot in ton of rock hoisted.	Lbs. mineral in ton of rock hoisted.	Lbs. of ingot in fathom hoisted.	Lbs. of mineral in fathom hoisted.	Cost per ton.	Tons rock hoisted.	No. fathoms hoisted.
1.29	1.56	25.83	31.36	1.00	1.22	20.14	24.45	363	440	1.89	181,451	10,078

Total expenditure for the year at mine, $342,377.22; number of tons of rock manipulated, 181.451; cost per ton, $1.89, or less extra expense building sand wheel, coal dock, and new boiler $5,985.84, leaves mining cost $1.85 per ton.

Rock Account.

Number tons on hand in mine January 1, 1888	18,890
Number tons mined during year on contract	169,045
Number tons mined during year on company account	10,000
Total	197,935
Number tons hoisted during the year	181,451
Amount on hand in mine January 1, 1889	16,484
Number of acres of land owned	1,656.29

The following is the company's published report:

Franklin Mine Report.

Boston, *March, 1889.*

To the Stockholders of the Franklin Mining Company:

The directors present the following report of operations for the year ending December 31, 1888:

The mine produced 4,437,602 pounds of mineral, which yielded $82\frac{3.8.1}{1000}$ per cent, or 3,655,751 pounds of refined copper, from which has been realized an average price of 15.0754 cents.

Below is given a summary of the year's business:

Receipts.

3,665,751 lbs. copper, at 15.0754 cents		$551,119 53
Interest		891 43
Silver		2,727 28
		$554,738 24

Expenditures.

Running expenses at mine (including construction account) as per yearly cost sheet	$342,377 22	
All other expenses including smelting, freight, insurance, etc.	64,205 80	
		$406,583 02
Showing the income of the year to be		$148,155 22

The total amount of rock hoisted during the year was 181,451 tons.
The total amount of rock stamped during the year was 143,347.
Pounds of mineral in ton of rock stamped 31.36.
Per cent of mineral in ton of rock stamped, 1.56.

Captain Johnson Vivian is still in charge at the mine, and the good results obtained are largely due to his ability and untiring energy.

His report gives particulars of the work at the mine, states the present condition of the property, and the prospects for the coming year.

The usual financial statements are submitted.

For the directors,

D. L. DEMMON, *Treasurer.*

FRANKLIN MINING COMPANY—CASH ACCOUNT FOR YEAR ENDING DECEMBER 31, 1888.

Cash on hand January 1, 1888	$133,506 47
" received from sales of copper, 3,818,016 lbs., at 14.492 cents	569,706 29
" " " sale of silver	2,727 28
" " " interest	891 43
	$706,831 47

Contra.

Cash paid dividends January 2 1888	$40,000 00
" " " July 2, 1888	80,000 00
" " mine agent's drafts	364,835 67
" " insurance	752 11
" " storage	691 40
" " smelting	36,764 32
" " freight	13,469 25
" " expense, brokerage, taxes	10,734 37
" on hand Dec. 31, 1888	159,584 35
	$706,831 47

D. L. DEMMON, *Treasurer.*

FRANKLIN MINING COMPANY—ASSETS AND LIABILITIES—DECEMBER 31, 1888.

Assets.

Cash on hand	$159,584 35
Copper (sold)	55,813 17
Supplies at mine	90,978 10
Notes and accounts receivable	36,035 67
	$342,411 29

Liabilities.

Drafts outstanding	$17,139 01	
Liabilities at mine	26,899 78	
Accounts payable	9,040 16	
		53,078 95
Surplus December 31, 1888		$289,332 34

From which a dividend of two dollars per share, or $80,000, was paid January 1, 1889.

D. L. DEMMON, *Treasurer.*

OFFICE OF THE
FRANKLIN MINING COMPANY, HOUGHTON CO.,
Hancock, Mich., January 10, 1889.

D. L. DEMMON, ESQ., *Treasurer:*

DEAR SIR—The following report of our operations for the year ending December 31, 1888, with map of the mine, which has been carefully surveyed and marked up to date

showing the extent of the openings, stopes, etc., with inventory of supplies, tools, real estate, and machinery, also tabular statements giving in detail the cost of each department of our works, is respectfully submitted.

SURFACE.

To facilitate and cheapen the handling of coal at the lake, we have erected some trestle work on or near the dock, and made some change in the tram-road from the bottom of the incline road to the landing, which has reduced the cost of transportation of coal from the lake to the mine five cents per ton. All necessary repairs to buildings, fences, roads, etc., have been made, which gives this department about the same appearance as it had a year ago.

MACHINERY.

The new Corliss engine referred to in my last annual report was started for regular work on the twenty second day of January last, and continues to run very smoothly and satisfactorily. Seven of the old two-flue boilers have been removed, and three of the fire-box pattern substituted therefor. Another of the same kind will be added in February next, which will doubtless supply all the steam necessary for our present machinery for many years. All our plant is in good repair, and has run without any hindrance of importance.

STAMP MILL.

The amount of rock treated was 143,347 tons, which is 6,207 tons more than was stamped for 1887. All things considered, the mill is in fair condition, and with proper care it will treat all the rock the mine can furnish for many years. Since the harbor lines have been established by the United States government in Portage Lake, the depositing of sand from our mill beyond said lines has been prohibited, consequently it became necessary to elevate the sand twenty-five feet higher, a year sooner than we expected to do so at the date of our last annual report, to enable us to carry it where there is sufficient room without encroaching on the harbor lines, for which we have erected a sand-wheel thirty five feet in diameter, with 1650 feet of launders, through which the sand is carried into the bay opposite the village of Ripley. With this arrangement the sand question is settled for many years. The wheel is operated by a 16x30-inch cylinder engine, which was provided for that purpose a year ago.

MINING.

The openings made are as follows :

Drifting on the main lode	2,364 7-10 feet.
Drifting on east lode and cross-cuts	625½ "
Sunk in shafts	364 "
Sunk in winzes	80 "
Total	3,434 2-10 feet.

The amount of rock hoisted was 181,451 tons, which is 7,577 tons over the output for 1887. The rock rejected was 38,104 tons, or 21 per cent of the amount taken out of the mine. The cost per ton of rock hoisted was $1.89, which is two cents in excess of the cost for last year, which is owing to the extra construction expense and increase of wages. The percentage of ingot copper in the rock hoisted is one per cent, which is a decrease of 12-100 per cent from 1887. This was caused by the falling off in value of the ground in the south part of the mine. No. 3 shaft has been sunk from a point

thirty feet below the 29th level to the 30th. This opening is still in the foot side of the main lode, consequently nothing can be said in relation to the value of the lode at this level until it is reached with a cross-cut, which will be done about the first of February. The lode at the 30th level, north of this shaft, which has been opened 240 feet, is not very productive; it contains some stamp copper, but will not pay to stope. The 29th level has been extended north 420 feet, all of which will pay to take out, except about 75 feet near the shaft. The twenty-eighth level, for a distance of 270 feet north of shaft, has exposed a large amount of good stoping ground. No. 5 shaft has been sunk from the 28th to the 30th level, all of which is in the hanging wall trap. At the bottom level the lode is in the foot wall, 25 feet from the line of the shaft, which has been exposed by cross-cut and opened at this level 65 feet. The lode at this point is about fifteen feet wide, and showing all grades of copper in good paying quantities. Drifting in this part of the mine has been done at the several levels from the 26th to the 30th level to the extent of 600 feet. The lode in these openings with but little exception will pay a good profit. There is a large amount of ground opened in this part of the mine that will yield as much copper per fathom *as any we have had in any part of the property for the last ten years.*

EAST LODE.

From time to time, for the last four or five years we have been exploring each side of the main lode with a diamond drill without the least success until July last, when we discovered, at the 30th level, 47 feet east of the main lode, an amygdaloid, 20 feet wide, bearing stamp and barrel copper in paying quantities. This lode has been opened at this level 288 feet, which has exposed some good stoping ground for at least 200 feet in length. The last eighty feet opened is not showing anything of value. In sinking a winze from the 30th to the 31st level some very rich stamp and barrel copper was met with. At the 31st level this lode has been cut into with a cross-cut which has shown it to be copper-bearing for fifteen feet in width. Some good stamp rock and some barrel copper is being taken out at this point daily. At the 29th level this lode has been intersected with a cross-cut, and opened on its line 128 feet. On the whole it is less productive than it is in the levels below, but some portions of it will afford some fair stamp rock, and will doubtless pay to stope. There is a large amount of ground ready for stoping on this lode that will yield in ingot copper *above the average of the main lode.*

PROSPECTS FOR 1889.

If the present appearance of the mine continues, and all runs smoothly and regularly, as it has done for the year just past, our product for the ensuing year will doubtless be about 2,200 tons, and our expenses will not be materially increased, if any.

My assistants, Capt. Thomas Dennis, who is in charge of the underground department, Mr. Arno Jaehnig, the clerk, and Mr. James Moore, the chief engineer, continue to promote the best interest of the company in the same faithful manner as they have done for many years.

Yours respectfully,

J. VIVIAN, *Superintendent.*

Year.	Tons.	Pounds.	Year.	Tons.	Pounds.
1857	3	699	1873	183	
1858	56	1,104	1874	23	1,790
1859	116	1,211	1875	583	800
1860	157	1,860	1876	963	641
1861	783	43	1877	1,169	1,817
1862	733	645	1878	1,299	1,528
1863	639	684	1879	1,414	1,703
1864	605	1,335	1880	1,168	466
1865	779	1,481	1881	1,338	1,932
1866	819	994	1882	1,632	120
1867	701	455	1883	1,744	1,308
1868	737	1,326	1884	1,882	1,697
1869	779	970	1885	1,999	1,172
1870	589		1986	2,132	297
1871	300	1,000	1887	1,975	1,832
1872	186		1888	1,827	1,751
Total				29,568	61

No. shares 40,000; par value $25. Location of mine, Section 24, T. 55, R. 33. Mine office, Hancock, Mich. Boston office, 19 Congress street. *Officers of Company*—H. J. Stevens, President; D. L Demmon, Secretary and Treasurer; Johnson Vivian, Superintendent; Thomas Dennis, Mining Captain; Arno Jaehnig, clerk.

THE PENINSULA COPPER MINE

is again active—in the list of producers. After many years of idleness, a company was organized in 1882 that opened up the mine, built a new stamp mill and operated for two years. Since 1884 the mine has been practically idle.

Some work was done in 1886, but of little significance or value.

The estate comprises 2,560 acres, situated in Sections 7, 8, 9, 10, 11, T. 55, R. 33, W. and the mine, which was first worked in 1860, is in a conglomerate belt, identical with the Allouez.

It was formerly known as the Albany & Boston, but the belt is undoubtedly the Allouez conglomerate, and the mine presents the same characteristics as are found at the Allouez and at the conglomerate mines in Keweenaw county.

There are limited portions—so-called copper-shoots—that are very rich; but also, comparatively, a great deal of barren ground. It is only to be ascertained if there is enough good stoping ground to render it a paying mine under fair conditions.

The high price of copper in 1888 afforded the stimulus for the renewal of activity. Accordingly in June last the pumps were started. The plan is to open the mine more extensively than it has been done heretofore with the view to selecting the paying ground and avoid that which is the reverse. At the time I visited the mine in January last, they were sinking the two shafts. No. 1 was below the 6th level and No. 2 below the 7th. The former at that date was 550 feet deep and the latter 600 feet. The first level is opened a length of 1,700 feet. The 2d, 3d, 4th and 5th levels are about 900 feet long, the 6th 300, and below that only sinking has been done.

The present officers are H. Z. Turell, Secretary and Treasurer; A. A. Spendlow, President, New York; W. A. Dunn, Superintendent, Houghton, Mich.

Capt. Dunn has commenced to drive a cross-cut east in the 4th level, 90 feet west of No. 2 shaft. The purpose is to find the Calumet & Hecla conglomerate. When I saw it the cross-cut was in 300 feet. It will be continued for 1,000 or 1,500 feet further, if necessary. The land is crossed by all the important lodes in the country. The bearing of the formation seems to be N. 40° E., and the dip 52° northwesterly. The length of the lode within the company's lines is 5,100 feet.

At the time of my visit the force employed was about fifty men.

The stamp mill was built in 1883, and has two improved Ball heads, 16″ cylinders, 10″ shafts, 48 iron frame, Collum washer. The mill is 1,386 feet from the rock house, with which it is connected by an inclined track which rises from the rock house to the mill 46 feet.

Capt. Dunn purposes to start the stamp mill by and by, but for a time he will only push the cross-cut and the openings.

The lode is a wide one—14 feet to 25 feet wide; a very coarse conglomerate. The location is pretty well provided with buildings. If the price of copper keeps up I do not see why the mine may not be successfully worked. No doubt some hope is based on the probability of cutting the Calumet & Hecla conglomerate.

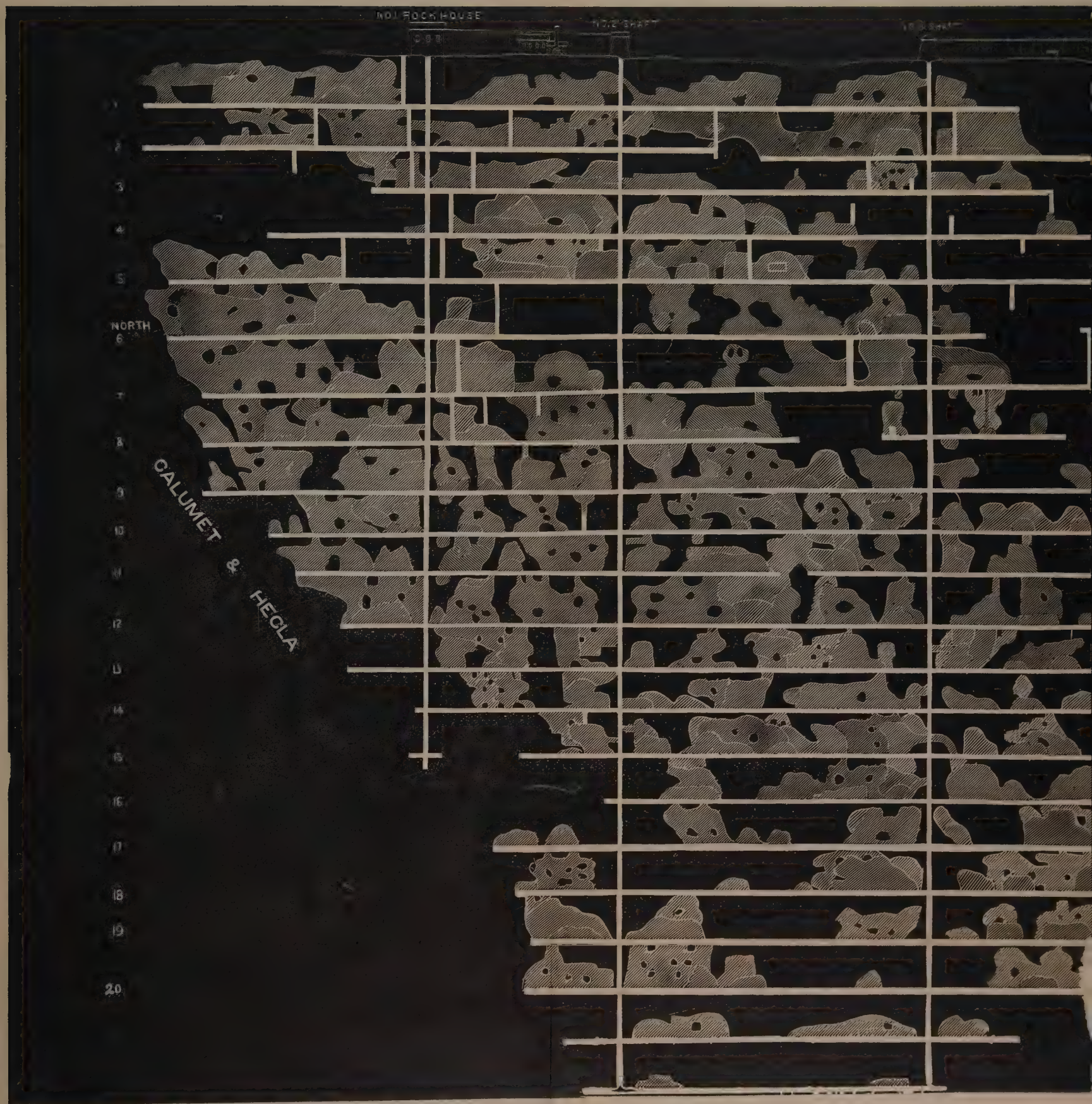
The mine has yielded 1,543 tons 1,071 pounds of copper.

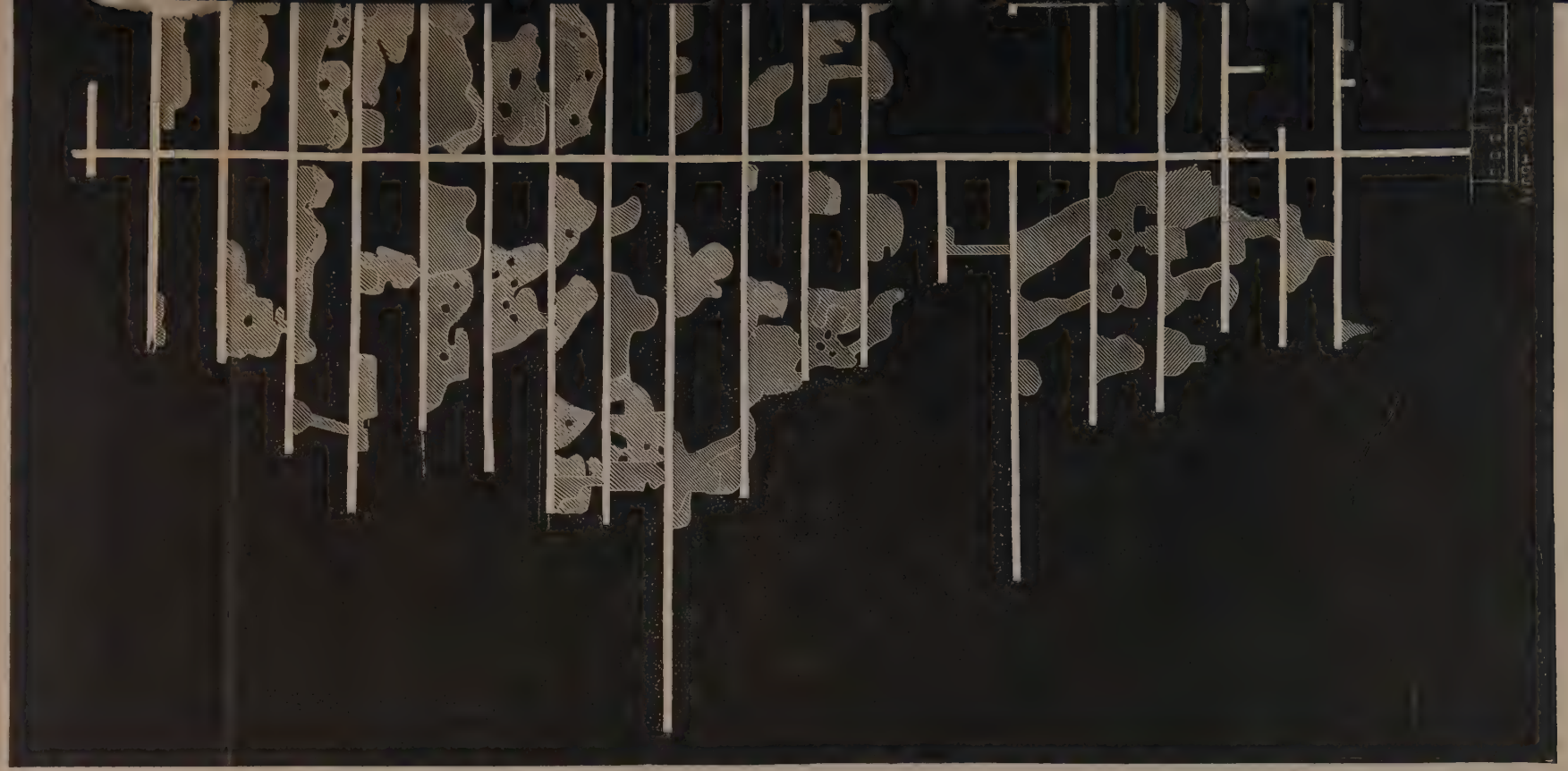
THE OSCEOLA

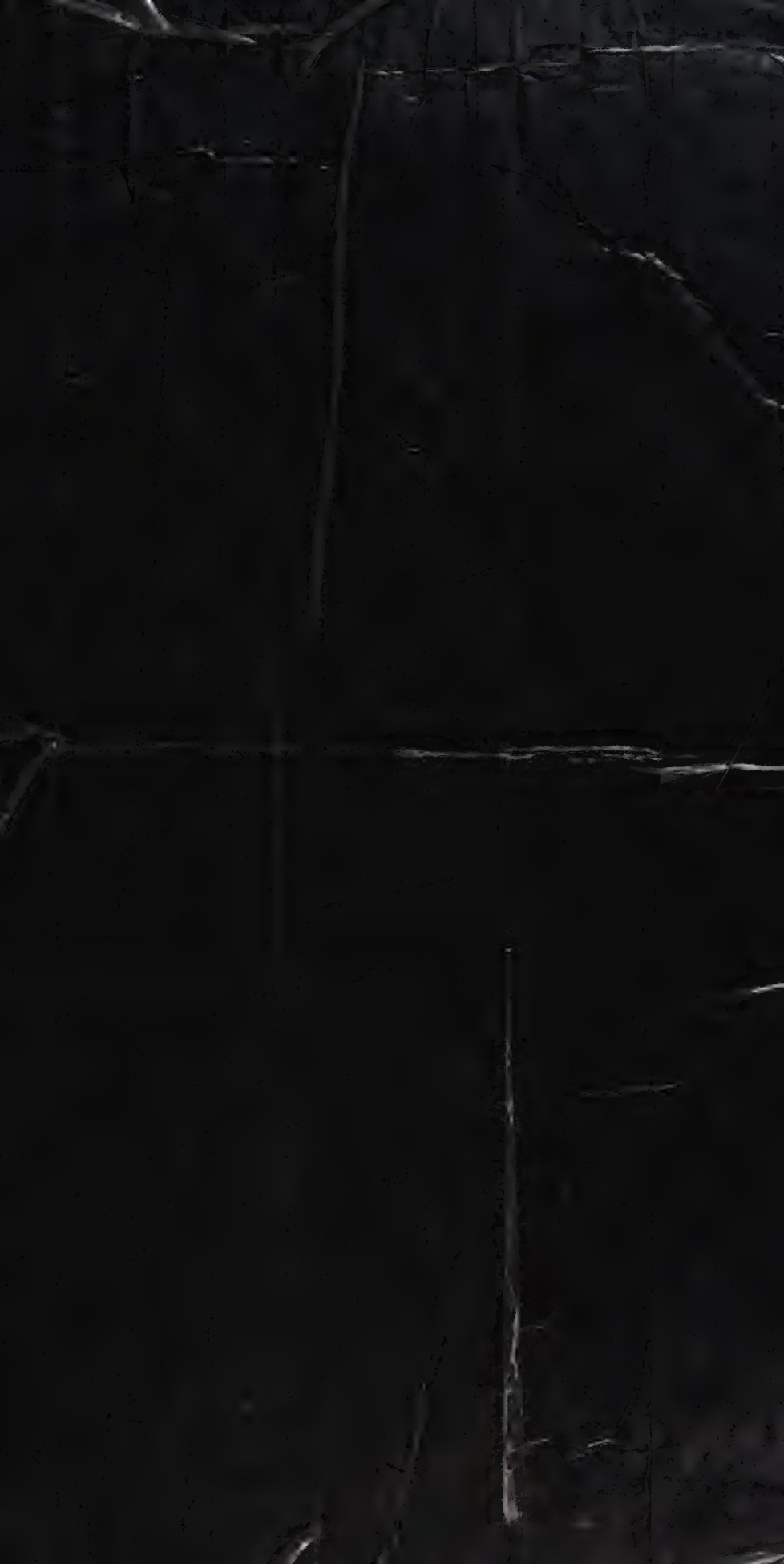
is an interesting mine to examine; its record is one of the most instructive of any in the country. I think it safe to say that there has been a larger amount of sinking and drifting—opening work—done in the Osceola mine than in any other mine in the State in the same length of time. The company has been successful. The mine has been a profitable one, but this result has

LONGITUDINAL SECTION OF THE OSCELA CONSOLIDATED MINE, JAN., 188

Scale: 240 feet to an inch.







been largely due to the excellent management. The mine yields copper in a fair ratio, that is, the rock mined and treated in the mill yields a fair percentage of copper; but to get this a vast deal of non-productive ground has to be gone through. The Osceola is a very irregular, bunchy, amygdaloid belt. It is sometimes so pinched and trappy as to be difficult to follow. The best portion of the mine has been at the north end adjacent to the Calumet & Hecla. But I have heretofore described the mine with sufficient fullness, and although I went under ground in the Osceola recently, I did not discover anything different from what it formerly appeared except that the ground at the south end is improving; but there are good stopes all through the mine in every level from the 5th down.

They are now sinking the "Opechee shaft" away at the south end of the mine, and some remarkably rapid work has been done. As, for instance, in December, this shaft—double skip—was sunk 80 feet with one drill at a cost exclusive of timber, etc., of $8.00 per foot.

The company's published report is so full and explicit that it is better to give it in full, and that with the map conveys all necessary information.

Osceola Mine Report.

Annual products of the Osceola mine are given in the following table:

Year.	Tons.	Pounds.	Year.	Tons.	Pounds.
1874	468		1882	2,088	782
1875	665	303	1883	782	2,128
1876	846	1,737	1884	2,123	1,630
1877	1,382	777	1885	969	1,169
1878	1,352	1,998	1886	1,780	786
1879	1,589	1,387	1887	1,791	1,723
1880	1,691	1,387	1888	2,067	320
1881	2,089	1,876			
Total				23,045	534

The directors present the following report of the operations for the past year, and statement of the financial condition of the company:

The product of mineral was 4,833,543 pounds, which at 85.53 per cent. gave 4,134,320 pounds of refined copper, for which has been realized the gross sum of	$621,275 14
Interest	675 17
	$621,950 31

The costs have been:

Running expenses at mine		$404,204 35	
Smelting, transportation, and all other expenses of selling copper		75,669 07	
			479,873 42
Showing a mining profit of			$142,076 89
The balance of assets, January 1, 1888, was		$235,516 15	
There has been expended in mine plant during the year	$22,907 89		
Deduct dividend of January 16, 1888	50,000 00		
Deduct dividend of June 15, 1888	50,000 00		
Deduct dividend of September 15, 1888	50,000 00		
		172,907 89	
			62,608 26
Making the balance of assets January 1, 1889			$204,685 15

It is doubtless well known to our stockholders that this company, as well as nearly all of the other copper producers of the world, has sold its production of copper for about three years to "La Societe Industrielle et Commercaile des Metaux de Paris," at 13 cents per pound, and in addition such sum as shall be equal to one-half of the net profits realized above this price on resales thereafter made of said copper. This sale was consummated April 20th last, and expires December 31, 1890, and, as a guarantee, a letter of credit in favor of this company was opened by "Comptoir d'Escompte de Paris," with J. & W. Seligman & Co., of New York, for $520,000. Thirty days before May 1, next, a similar letter of credit is to be furnished, and the same is true of the year following. Up to this time this letter of credit has been reduced to about $410,000, by deliveries of copper unsold. On resales, of course, the credits are not drawn against.

The high cost of our copper the last year, as compared with the previous year, will be noted. This was owing to the falling off in the quality of our rock in August, September, October and November. If one will take this report and compare it with that of the previous year he will see that under the head of "summary" the amount of refined copper per ton of rock in 1888 was 22.59 lbs., as against 24.68 lbs. in 1887. An average for the six years previous to 1887 gives 25 pounds as the amount of refined copper in each ton of rock stamped. In addition to the foregoing reason for high cost of copper, considerable development work was done, which was not profitable, but necessary. For further details regarding these matters we refer you to Capt. Daniell's report herewith submitted. It gives us pleasure, however, to state that the mine began to improve in November, and in December the amount of refined copper to the ton of rock stamped was 27.12 lbs., and January of this year will do equally as well, consequently we have reason to believe that the year 1889 will show better results than 1888.

It has been intimated in former reports that our smelting arrangements were quite unsatisfactory, and that plans for improvement in this direction were contemplated. We can now say that these plans are approaching completion, and we expect to begin smelting with the Tamarack-Osceola Copper Manufacturing Company early next summer. The furnaces now being erected by the said company are of the latest pattern, and we firmly believe that not only shall we make a considerable saving of cost in this department, but that the quality of the copper will be superior to anything we have been able to produce hitherto.

We call your attention to the treasurer's report, from which you can see that the financial affairs of the company are in a good condition.

JOSEPH W. CLARK, *President.*
ALBERT S. BIGELOW,
CHARLES VAN BRUNT,
GUSTAV STELLWAG,
GEORGE F. BEMIS,
JOHN N. DENISON,
JOHN DANIELL,
Directors.

ASSETS AND LIABILITIES.

Assets.

Cash in bank at Boston	$24,855 32
Cash on hand at mine	1,383 20
Supplies on hand at mine	29,356 78
Fuel on hand at mine and stamp mill	12,312 08
Accounts receivable at mine	33,658 94
Bills receivable at Boston	120,527 50
3,000 shares stock in Tamarack-Osceola Copper Manufacturing Co.	15,000 00
250 shares Hancock & Calumet R. R. stock	25,000 00
Copper on hand, 272,733 pounds, since sold	39,549 19
Total assets	$301,643 01

Liabilities.

Drafts outstanding	$28,435 33	
Accounts payable at mine	37,414 65	
Bills payable at Boston	29,921 88	
Dividends uncalled for	1,186 00	
Total liabilities		96,957 86
Balance of assets January 1, 1889		$204,685 15

STATEMENT OF RECEIPTS AND EXPENSES OF ALL KINDS FROM SEPT. 25, 1873, TO JAN. 1, 1889.

Receipts.

From capital stock, 50,000 shares, $25 a share, full paid			$1,250,000 00
From 936,003 lbs. copper		1874 at 23 37-100	218,736 92
From 1,330,313	"	1875 at 23 77-100	302,862 96
From 1,693,737	"	1876 at 20 57-100	348,333 25
From 2,774,777	"	1870 at 18 19-100	504,636 93
From 2,705,998	"	1878 at 15 53-100	420,340 14
From 3,197,387	"	1879 at 17 79-100	568,689 89
From 3,381,061	"	1880 at 19 15-100	647,487 19
From 4,176,976	"	1881 at 17 77-100	742,585 84
From 4,179,782	"	1882 at 17 70-100	739,458 26
From 4,256,409	"	1883 at 14 96-100	636,846 83
From 4,247,630	"	1884 at 12 82-100	544,651 02
From 1,939,169	"	1885 at 10 75-100	208,558 65
From 3,560,786	"	1886 at 10 51-100	374,144 13
From 3,583,723	"	1887 at 11 86-100	424,936 85
From 3,134,320	"	1888 at 15 3-100	621,275 14
46,098,070	"	total at 15 84-100	$7,303,544 00
From sales of silver to date			32,439 04
From interest receipts to date			36,886 04
From 360 shares Hancock & Calumet R. R. stock			36,000 00
Total receipts			$8,658,879 08

Expenses.

Running expenses prior to 1888	$5,485,072 67	
Running expenses during 1888	479,873 42	
		$5,964,946 09
Construction expense prior to 1888	$714,536 44	
Construction expense during 1888	22,907 89	
		737,444 33
Real estate		588,836 70
Dividends prior to 1888	$1,022,500 00	
Dividends during 1888	150,000 00	
		1,172,500 00
Exploratory work		15,466 81
Total expenses		$8,479,193 93
Balance of receipts January 1, 1889		$179,685 15
Add 250 shares Hancock & Calumet R. R. stock		25,000 00
Balance of assets January 1, 1889		$204,685 15

Details of Mining Expense.

Shaft sinking 534.8 feet at 18.54	$9,915 79	
Winze sinking, 712.8 feet, at 11.23	8,004 30	
Drifts, 2,933.6 feet, at 6.59	19,326 59	
Stoping, 12,069.12 fathoms, at 11.19	135,133 00	
Tramming	39,124 58	
Timbering, labor, materials and supplies	6,418 68	
Extra work	1,335 10	
Supplies, fuel, labor, etc., for air drills	35,283 25	
Supplies, fuel and labor for engines	37,524 85	
Mining superintendence and company account, labor	19,782 44	
Blacksmith, machinist and carpenter labor	2,482 70	
	$314,331 28	
Less profit on supplies	36,393 00	
		277,938 28

Other Expenses.

Rock house	$20,089 92	
Surface labor, supplies, etc.	2,998 03	
Incidental expense, including taxes	6,240 94	
Office labor, supplies, etc.	5,515 55	
Transportation	28,596 73	
Stamping	62,824 90	
		126,266 07
Total running expenses		$404,204 35

Construction Costs.

New engine and boiler house at Opechee	$3,929 63	
New compressor and building	14,107 24	
Dwelling houses at mine	3,195 73	
Stamp mill construction	899 46	
Dwelling houses at stamp mill	775 83	
Total construction costs		$22,907 89
Total expended at mine		$427,112 24

Summary.

Rock stamped	183.036 tons.
Product of mineral	4,833,543 lbs.
Product of refined copper	4,134,320 lbs.
Yield of refined copper per ton of stamped rock	22.59 lbs.
Yield of refined copper per cubic fathom of ground broken	359 lbs.
Yield of mineral per cubic fathom of ground broken	420 lbs.
Percentage of mineral in stamp rock	1.32 per cent.
Percentage of refined copper in stamp rock	1.13 per cent.
Cost per ton of rock hoisted	$1 95
Cost per ton of rock stamped	2 21
Refined copper, cost per pound at mine	9.78 cts.
Cost of smelting, freight and all other expenses	1.83 cts.
Total cost per pound of refined copper laid down in New York	11.61 cts

SUPERINTENDENT'S REPORT.

OPECHEE, *February 8, 1889.*

To the President and Directors Osceola Consolidated Mining Company:

GENTLEMEN:—I beg to submit the following as a report of our operations for the year 1888.

Our expectations for the year, expressed in last report, were not met. The stopes very unexpectedly fell off in yield, and as is usual when working in lean ground, we found the lode narrow. This last materially enhanced the cost of breaking rock. The difference in yield, comparing with the preceding year, in rock hoisted, was one pound of ingot copper per ton. The rock stamped shows a difference against us of over two pounds of copper per ton. It cost nine cents per ton more to manipulate stamp rock. Smaller credits for work done at stamp mill, and the reason before given, costlier stoping, accounts for this.

We hoisted 207,292 tons of rock, and sent to mill 183,036 tons—the proportion discarded being less than usual. These figures show that 11,516 fathoms of ground were broken and treated. The product was 4,134,320 lbs. ingot copper, or 359 lbs. per fathom—nearly 20 lbs. per ton of rock.

The opening work underground for the year foots up as follows:

Shafts	534.8 feet.
Winzes	712.8 "
Levels	2,933.6 "
	4,181.2 feet.

Sinking of shafts for the year, and their depths at the end of the year, is shown below.

Shaft.	Sunk.	Depth from surface.
No. 1.		1,387.1 feet, 18 feet below 15th level.
" 2.	120.1 feet.	1,995.9 " 20 " 22d "
" 3.	97.2 "	1,995.5 " 20 " 22d "
" 4.	156.5 "	1,853.2 " 20 " 21st "
OPECHEE:		
No. 5.	161.0 "	575.0 "

The different levels have been extended as follows:

11th level,	20 feet.	19th level,	212 feet.
16th "	173.6 "	20th "	511.9 "
17th "	331.6 "	21st "	711.3 "
18th "	345.7 "	22d "	627.1 "

I will briefly refer to the character of the ground opened at the different levels and shafts.

No. 2 shaft in sinking to the 22d level was generally below the most productive part of the lode, in the foot wall part of it.

Occasionally it showed some good patches of copper rock, but as a rule it would be rated as poor. Recent sinking has shown the hanging wall of the lode in the shaft, and we have had moderately good copper ground.

The 22d level was drifted north of No. 2 shaft 52 feet. The lode here is narrow and lean. The 21st level, north of No. 2 shaft, has been extended 120.4 feet. The lode here is comparatively soft, and is very nearly average quality. Communication between No. 2 and No. 3 shafts has been made at 22d and 21st levels. The 22d level opened copper ground for its whole length, some of it being quite good. Stopes now at work are above the average, both in width of lode and productiveness. The 21st level afforded a good deal of stoping ground, but the lode is bunchy, and on the whole is not above average.

No. 3 shaft at 21st level was in the hanging wall trap. In sinking the lode was found in the line of the shaft, and has continued to present bottom. We find fairly good ground for copper. The lode is of average width, and is quite promising.

Drifting 22d level south of No. 3 shaft 53.2 feet showed some fairly good ground near the shaft, but later not very good. The 21st level south of No. 3 shaft has been drifted 110.6 feet. Judging from the level over we expected good ground here, but have so far seen nothing of value. Lode is narrow. Later, when communication is effected with No. 4 shaft, this ground will be tested by stoping, and above the poor bar, copper ground will no doubt be found.

The dip of the lode near No. 4 shaft has been quite irregular. In sinking the shaft we have been wholly in the hanging wall trap, and again in the lode more than once. In present bottom the lode is exposed and it is good for copper. The 21st level north of No. 4 shaft, like the same level south from No. 3 shaft, has been poor. This is no unusual occurrence, and we shall not hesitate to test the ground by stoping. The 20th level south of No 4 shaft has been drifted 334.1 feet. Ground of much promise is laid open here the full length, the last 125 feet drifted showing a very good lode, and the advanced breast is good. The 19th level south of No. 4 shaft has been extended 164.5 feet. The lode has been good all the way from shaft to present end. The 18th, 17th and 16th levels, extended respectively 345.7 feet, 331.6 feet and 173.6 feet, have all been good for copper. Short, poor bars have been encountered, but all the ground opened is better than average quality. Both 18th and 17th levels are nearly 600 feet from shaft. These openings afford such proof of the extension of our better ground south that we could not hesitate about sinking Opechee shaft. As will be seen by reference to the section and plans of the mine, our stoping has been scattered a good deal through the different levels. We could have drawn more heavily on the ground south of No. 4 shaft to good advantage, but our hoisting facilities at that shaft have been wholly employed.

For the last three months our stopes have shown quite an improvement, and appearances today would warrant the expectation of a continuance, but I would hesitate after last year's experience to lead you to anticipate anything materially better than we have averaged, for changes come very suddenly. Whatever may be the outcome, the mine is now showing very well. I do count this year in getting our rock broken cheaper than last year. A greater width of working ground will ensure this.

Opechee shaft, or No. 5 shaft, has been unwatered, enlarged to size for two skip

roads, and sunk 161 feet. It was down, at the close of the year, about 580 feet from the surface. Last month it was sunk 80 feet. The intention now is to sink to 12th level, and communicate at that depth with our main workings. In sinking we find a little copper, but the character of the lode does not indicate long courses of copper ground. Deeper, there is no doubt but that we will encounter as good ground as we have in the mine. We shall push the sinking as fast as possible, feeling that it is a matter of great importance to attain sufficient depth to draw a part of our product from this shaft, which, ultimately, I have no doubt, will be *the* shaft of the mine.

Work on the west amygdaloid was discontinued early in the year. There is copper still to be found there, but the irregularity of its occurrence is most perplexing, and for some time we could not feel assured we were taking it out at a profit.

Through the rock houses we passed 207,292 tons of rock, aud discarded 24,256 tons. 183,036 tons were sent to the mill. Cost of handling, on account of increased quantity, was a little less than the preceding year, 9.68 cents per ton.

The mill stamped 183,036 tons beside 9,978 tons for Tamarack, and 19,425 tons for Kearsarge mine, in all, 212,439 tons, at a cost for the whole of 37.9 cents per ton. Mineral product from mill was 4,545,941 lbs. In addition we got barrel work 287,602 lbs., or a total product of 2,416 1543-2000 tons mineral. This afforded 85.53 per cent. ingot.

Construction account is comparatively heavy on account of our erecting a new air compressor. The machine is provided with compound cylinders, steam and air. It works very well, reducing our expenditures for fuel. The capacity is equal to running 16 drills.

At Opechee, besides providing the necessary equipment for shaft sinking, pumping, hoisting, etc., we have built eight dwellings for employes. One house has been erected at the mill, and we have purchased three dwellings from former employes.

Detailed statement of accounts prepared by Mr. Reeder, our clerk, and plans by Mr. Klepetko, our engineer, should accompany this.

Everything has run regularly during the year. My assistants have faithfully and intelligently given the company their best services.

Yours very truly,

JOHN DANIELL, *Superintendent.*

THE TAMARACK MINE

occupies a large measure of public attention. No company has been more richly rewarded than the owners of this mine, and none better deserves the recompense.

I find very little to add to what I have heretofore written. I have been to the bottom of the mine and through it twice during the past winter, and find it to be as interesting and valuable as ever.

Heretofore it has been impossible to keep the mine greatly opened, since the length of the mine has been so short, and the desire to make as large a product as possible, have caused the stoping to be kept well up with the opening. Now, as greater depth is attained, the lower levels are of much greater length, and there can be an increase of product without crowding the work.

But the most important fact is that No. 2 shaft is completed down into the mine. Heretofore the mine has had but a single shaft. Three cages to be sure but simply worked in compartments of the one shaft. Now there are two independent shafts, each with three compartments. No doubt they all, officers and men, feel easier. Half a mile down into the earth with but a single artificial avenue of escape, and that a vertical one, straight up from the bottom. No. 2 is directly north from No. 1,731 feet, and will intersect the lode 2,600 feet from the surface. The engine house has been built at No. 2, and the machinery provided. In January the shaft was sunk 93 feet, and they hoisted in same month, in No. 1, 17,000 tons of rock.

The Tamarack company is an educator in mining work and keeps in the advance. In the past year it has introduced the solid foundation in No. 3 stamp head, and as a result it is safe to say that no more stamp heads will be put up with the time-honored spring bottom. Men in mining, in metallurgy, in everything in fact, greatly reverence custom. A process or method or way of doing any sort of work that has the sanction of authority, is sure to be followed and slow to be relinquished. Somehow it came to be considered as necessary that spring timbers should be put under the stamp heads to receive the blow; otherwise, it was maintained, that the shaft would become crystalized and break. Of course with a spring bottom the blow must be far less effective, but nevertheless it has been assumed that this drawback must be borne, because the shaft would break if the bottom were solid.

The Tamarack company, last summer, had No. 3 stamp head built with a solid iron bottom, and the result of the work has been watched with great interest. It is found to crush far more rock than either of the others, and not the least injury to shaft or other portion of the machine is observed. It is surprising to stand by this stamp and find no jar, while the others, on the old plan, make everything shake. The anvil to receive the blow contains forty-six tons of iron, and the head has crushed 322 tons in a day.

The Tamarack company is the owner of a large estate, and may, in time, rival the Calumet & Hecla as a producer. It has already begun the work of sinking two additional shafts in the west half of section 11, a mile north of the mine. These shafts, 3 and 4, will have to be sunk to a depth of about 4,000 feet to reach the conglomerate. I have not the data to make the exact estimates.

It is an entirely feasible undertaking, and there is scarcely a question but they will open into ground equally productive with any in this lode.

At No. 2, the drum is 30 feet diameter; engine 45″x7 feet. A "tail rope" will be attached to the cage. The shaft—No. 2—has not reached the conglomerate yet, but has intersected a cross-cut driven from No. 1 shaft. Its

length from the surface to this cross-cut is 2,202 feet. The work has been in progress about three years, and the average monthly descent has been 60 feet.

The cross-cut was made for the sole purpose of coming under the shaft, and the intersection corresponded exactly with previous estimates, proving the correctness of Mr. Frank Klepetko's engineering.

The following is taken from the company's report:

The officers present the following report of the operations during the year ending June 30, 1888:

The production of mineral was 13,607,224 pounds, which at 76.36 per cent, gave 10,389,867 pounds of refined copper, for which has been realized the gross sum of		$1,448,943 88
The costs have been—		
Running expenses at mine	$412,723 53	
Smelting, transportation, and all other expenses	184,515 54	
		597,239 07
Showing a mining profit of		$851,704 81
Add balance of assets July 1, 1887		25,445 26
		$877,150 07
Deduct dividend No. 1, paid April 1, 1888	$120,000 00	
Deduct amount expended in mine plant during the year	150,985 95	
		270,985 95
Making the balance of assets		$606,164 12

We feel that the results of last year must be very pleasing to every stockholder. The promise of producing copper at a cost of six cents a pound has been more than realized. In fact, we can safely say that the figures of cost shown above have never before been equaled by any copper mine in the world. Our third head of stamps has been in operation less than two months; we think it proper, therefore, to call the attention of the stockholders to the fact that these low figures of cost were obtained from the running of but two heads of stamps; that when the mine is sufficiently opened to warrant the running of four heads of stamps, say in two years time or less, even these figures will be materially lessened. Comparing the diagram annexed with that attached to last year's report, the amount of mine work accomplished during the year, and the small amount of ground necessary to take out, to produce over ten millions of pounds of copper, can be easily seen, and gives one somewhat of an idea of the life of the mine, for it should be remembered that the diagram referred to is a section of but eighty acres out of 1,160 acres of land belonging to the company.

We made our first dividend of $3 per share in April, our second of the same amount in July, and the third, of $5, will be paid in October. We hope and expect to continue quarterly with $5 per share, making for the future $20 a share annually; leaving, we trust, a respectable surplus.

To total cash assets, June 30, 1888		$690,306 30
To total liabilities		84,142 18
Balance of assets		$606,164 12
Total receipts from all sources	$2,889,831 33	
Total expenditures	2,283,667 21	
Balance of receipts		606,164 12

DETAILS OF MINING EXPENSE.

Underground Expense.

Shaft sinking, 110.80 feet, at $20.00	$2,216 00	
Winze sinking, 366.40 " 11.60	4,249 15	
Drifts, 3,339.24 " 9.56	31,938 47	
Stoping, 5,920.00 fathoms at 11.86	70,215 21	
Tramming	28,846 12	
Timbering, labor, materials and supplies	37,222 36	
Extra work	5,566 87	
Supplies, labor, fuel, etc., for air drills	29,306 88	
Supplies, fuel and labor for engines	33,823 21	
Mining superintendence and company account labor	36,736 85	
Blacksmith, machinist, and carpenter labor	4,284 64	
		$284,405 76
Less profit on supplies, etc.		19,247 00
		$265,158 76
Other expenses—Rock house, surface, office, stamping, etc.		147,564 77
Construction account, total		150,985 95
Total expended at mine		$563,709 48

Summary.

Tons of rock stamped	144,412
Product of mineral	13,607,224 lbs.
Product of ingot copper	10,389,867 lbs.
Yield of refined copper per cubic fathom of ground	1,228 lbs.
Yield of refined copper per ton of rock stamped	71.95 lbs.
Percentage of refined copper to rock stamped	3.60
Cost of refined copper per pound at mine	3.97 cts.
Cost of smelting, freight, commission, and Boston expenses	1.78 cts.
Total cost of copper per pound in New York	5.75 cts.

The following is taken from report of Superintendent Daniell, June 30, 1888:

Results must be considered satisfactory. Compared with the previous year the out-put of rock from the mine was largely increased and the copper product more than doubled. Much less rock proportionately was discarded as poor from the rock house, and we obtained from what was sent to mill over 1 per cent. of ingot more. Each fathom of conglomerate rock broken and treated afforded 1,228 lbs. ingot against 831 lbs. in the previous year, a difference of 397 lbs. in our favor.

With an increased out-put the cost of handling rock has been lessened, the cost of stamp rock for the year being $2.86 per ton. This from a mine so deep as ours, continually increasing its force, and necessarily employing much labor untrained to our requirements, is at least doing fairly well.

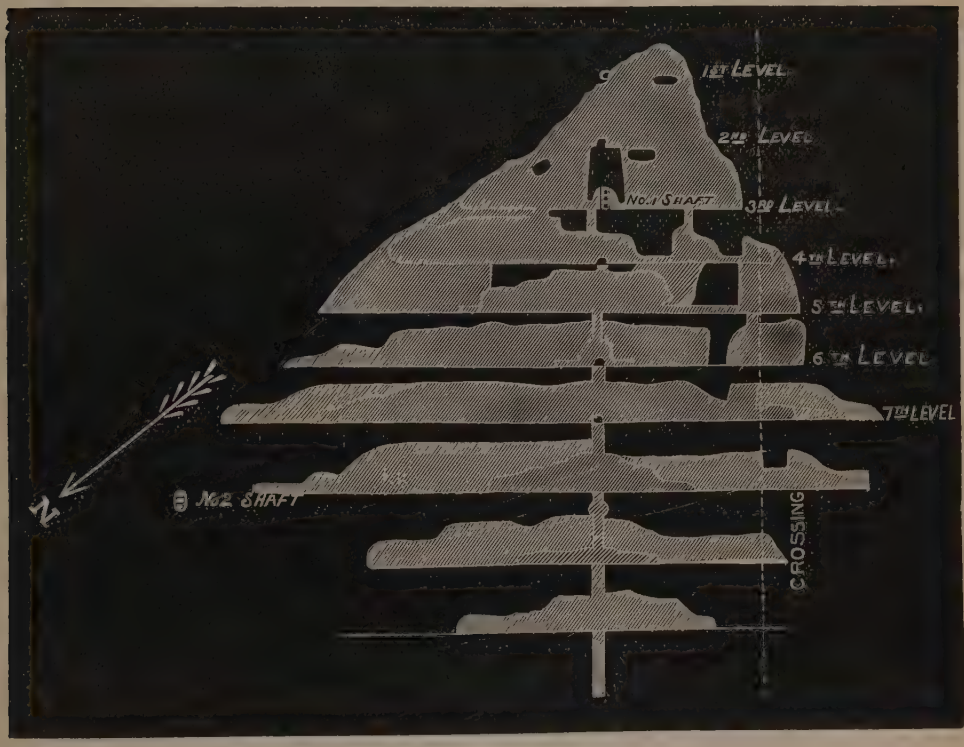
During the year No. 1 shaft has been sunk 110.8 feet, making the depth 2,570 feet from surface, and 22.5 feet below 9th level. The 10th level has nearly been reached since, and cross-cutting from the shaft will soon be under way. Two headings are now being run from a winze at 10th level, one towards the shaft, the other towards the conglomerate. It will require three months to get in good running order at 10th level, so as to break and send rock to surface from the conglomerate from that depth.

Opening work for the year foots up as follows, viz.:

No. 1 shaft sunk	110.8 feet.
No. 2 shaft sunk	771.4 "
	8882.2 feet.

LONGITUDINAL SECTION OF THE TAMARACK MINE, JAN. 1, 1889.

Scale: 300 feet to an inch.



Winzes, conglomerate	366.4 feet.	
Winzes, country rock	132.6 "	
		499.0 feet.
Levels, conglomerate		1,988.4 "
Cross-cuts		1,350.8 "
Total		4,720.4 "

There is nothing to indicate any decline in the size or richness of the lode, and we then can only infer that we are but entering on a very prosperous career.

The quantity of rock handled for the year was 162,945 tons; 10,590 tons, from openings in country rock, were stowed underground, much of it in back of 4th and 5th levels; 152,355 tons were sent to the rock house, and 144,412 tons to the mill, the quantity discarded as poor being 7,943 tons. The quantity of rock hoisted from the conglomerate workings equals 8,461 fathoms of ground. Mineral produced, 13,607,224 lbs., at 76.36 per cent equal to 10,389,867 lbs. ingot. Boulders smelted without stamping, 302,223 lbs. Ingot in stamped rock equals 3.597 per cent.

No. 2 shaft was sunk for the year, 771.4 feet, making the depth June 30th last, 1,402.8 feet. In the last two months 164 feet have been sunk, making the depth to date from collar of shaft, 1,566.8 feet.

We have done good work in sinking recently; last month 85 feet. A cross-cut at 2d level has been drifted from vicinity of No. 1 shaft towards No. 2, and is now within 100 feet of being under it. If we maintain late rate of sinking, early in April next we shall effect communication between the cross-cut and shaft, and this is a matter of great importance to us. Communication made, we shall use all diligence to carry the shaft to the bottom of the mine. Next year, then, we expect to be in position to materially increase our rock output, and this from what we consider is the best part of the mine.

Hoisting plant for No. 2 shaft has been ordered, and will be ready for erection early next spring.

The quantity of rock mined last year was larger than we anticipated a year ago, and in excess of the capacity of our stamp mill until we got No. 3 head ready to work—11,203 tons were treated for us in Osceola Mill, 133,209 at our own. Cost of stamping was 55.15 cents per ton. In Tamarack mill, 53.06 cents. We can do better than this, without doubt. The cost of stamping, after No. 3 head was started, was less than 50 cents per ton. In matter of duty our mill has done good work. There was no delay from imperfect machinery. Early in May, No. 3 head was started up. In construction of this, the use of oak spring-timbers to support the mortar and mortar-block have been discarded. Solid bed of iron, about 45 tons, has been substituted, apparently with perfect success and good results. The years average duty shows 216 tons of rock stamped for 24 hours' running time. In the last two months we got over 230 tons from each head in 24 hours.

Our construction work continues to be important. At stamp mill we put in an additional head of stamp, with jigging machinery, slime tables, etc., and added an additional boiler. We spent about $5,000 in bringing in the water of the Hungarian river. Probably this will give us water for three heads of stamps, without pumping, for four months in the year, and sufficient for one head much of remaining time. The water comes into the mill through a pipe which gives 200 feet of pressure, and this we regard as an important protection in case of fire.

THE TAMARACK, JR.,

is a creation of the original company. The estate consists of three "forties" in section 11, E. ½ S. E. ¼, and S. E. ¼ N. E. ¼, sections 11, 56, 33. The work of sinking two shafts is progressing favorably. May 1st, No. 1 has a depth of 775 feet, having progressed at the rate of 63 feet per month. No. 2 is at a less depth.

In company with Capt. Daniell I made an inspection of the location in February last, and was well pleased with all I saw. Probably in two years the mine will be producing copper. The land was set off from the old company on an equitable basis. No. 1 had cost, when at the depth of 476 feet, $23,663.87, and No. 2—305 feet deep—had cost $18,810.88, being $61.68 per foot. The total expenditure up to January 1, 1889, at mine was $107,119.48.

No. 1 shaft is 3-compartment, same as No. 1, Tamarack, while No. 2 is 4-compartment. They are 800 feet apart. The estimated outlay to sink these shafts and to equip them is $800,000. A plant has been erected at each shaft to suffice for the work of sinking. But if the mine proves to be as anticipated more powerful machinery will be finally required. The sinking was begun just a year ago, May, 1888. Preliminary work began in March previous.

Capt. John Daniell, General Manager of the Tamarack, Osceola, etc., mines, also superintends the Tamarack, jr. The mining captain is John Cruse; A. C. Bigelow, Secretary and Treasurer, J. W. Clark, President, Boston.

The Tamarack company has other irons in the fire. It is carrying on other industries that are of much importance to the country. At Dollar bay, on the north side of Portage lake, the company has engaged in the manufacture of copper wire and sheet copper, etc., and is carrying on the business extensively. They have a large saw mill and are making also the finished products of lumber used in building.

Besides these they have works nearly completed for smelting their copper. Hereafter the copper produced in the Tamarack, Osceola and Kearsarge mines will be smelted at the company's works.

All these industries are conducted by the Dollar Bay Improvement Company, the chief officers of which are the same as those of the mines above mentioned.

From Hancock, now, along the north side of Portage lake, and the west side of Torch lake is much activity. Stamp mills and smelting works, etc., employ a large number of men, and this locality has become a busy one. The dwellings, public buildings and places of business are unusually good. Altogether it is a pleasant and prosperous portion of our State.

THE CALUMET AND HECLA MINE

has occupied a larger measure of public attention of late than ever it did formerly. Much interest has centered in the fire that has prevailed for so long in the mine, and the effect which this misfortune to the company would have on the copper production of the country and on the price of the metal in the markets.

The fire, which is not yet out, started on November 29 last—Thanksgiving night—in No. 3 Calumet shaft, and eight men, whose names are known, were destroyed. Since that date—five months—no copper has been produced in what is known as the Calumet and Hecla mine proper. The product has all come from the South Hecla, or Black Hills mine as it is called, which is in the same deposit, but more than half a mile south, next to the Osceola.

The Calumet and Hecla mine, as its name implies, is a consolidated company. The Hecla mine on the south in Sec. 23, and the Calumet on the north; the dividing line is the section line between sections 23 and 13, T. 56, R. 33. The shafts are numbered from this boundary each way, 1, 2, 3, etc., Calumet, and 1, 2, 3, Hecla. In the Calumet there are five shafts, and in the Hecla 4—that is, in the original Hecla, but further south, in the Black Hills mine, are 9, 10, 11 and 12, besides shafts 7 and 8, which are sinking. The total length of the mine, from the south end to the north line of Sec. 13, measured along the conglomerate belt, is about 14,000 feet. What has been deemed barren ground between the Hecla and Black Hills mine is rapidly approaching the line of production. The Black Hills shoot of copper passes through it and is reached in the Tamarack mine. Nos. 7 and 8 shafts will soon be in this productive ground, when the Black Hills mine will have a greatly increased length. The present fire began in No. 3 Calumet shaft in the 6th level. It was thought at the time of its occurrence that it would soon burn out, and would not be likely to spread; but it has proved to be a far more serious matter than was anticipated. As to the origin of the fire, the chief officers of the company declare that it was set on fire, and a reward of $10,000 is offered for the apprehension and conviction of the perpetrator of the crime; but after five months the incendiary has not been found.

The majority of mining men, I think, are of the opinion that the fire resulted from the friction of the rollers in the shaft. There is a good deal of movement in the ground; it swells and expands, and pinches the timbers, causing the shafts to become smaller, requiring that they be constantly trimmed, etc. The tracks get displaced slightly, and tend to bind the rollers

that are laid in them to support the heavy wire rope that draws the skip. This rope, running down at the rate of 1,500 feet per minute sometimes, I am told, generates sufficient heat to ignite a roller if it happens to be bound so that it will not revolve. Incipient fires of this origin have occurred, not only in the Calumet, but in other mines. The mine being so large, with so many shafts, and down to such a depth—39 levels—that there is great opportunity for the circulation of air; also, it is a network of dry pine timber, and, in the old levels, cedar lagging, which burn like tinder.

In February last I was at the mine when the officials expressed the opinion that the fire was all out. Communication between No. 5, which is the shaft furthest north, and the rest of the mine was shut off by stopping the levels at No. 5, and the work of freeing the mine of water by bringing it up in the skips and with pumps was begun. The coverings had been taken from over the mouths of the shafts, or so adjusted as to secure a circulation of air that should free the mine of noxious gasses. Men had descended No. 4 shaft to the 22d level, and gone through to No. 3, etc. So that at that time, early in February, it was expected to be hoisting in Nos. 4 and 5 Calumet and No. 3 Hecla in a few days. But the draft introduced to get rid of the foul air, served to ignite smoldering flames, and the mine was speedily ablaze again, since which time the shafts have been closed, and various devices resorted to to extinguish the flames. Many holes have been bored from the surface into the mine to the portions where the fire exists, and sand, dirt and water run down. For many months the mine was closed down in 1887, and until June 1, 1888, when they again began to hoist, and continued to do so until November 30, when the fire now existing broke out.

The mine was again opened on May 1, 1889, and the officers think that the fire is out.

There is always something new to be seen at the Calumet and Hecla in the way of machinery. The fine stone engine house at the Hecla is by far the best in the country. The new hoisting machinery is a marvel to behold. I do not know where one will find any so beautiful. The hoisting machine house is 68′x112′, and attached boiler house 68′x72′, both of stone, iron roof. The stack is 200 feet high, 20′ outside diameter, 9′ 4″ inside. Three hoisting engines, 3 conical drums, 26′ diameter at large end, will coil 5,400 feet of rope each.

The shafts at South Hecla, in February, were at 14th level, 6 and 7 were at the 5th level, corresponding to the 7th level in the old mine, or about 500 feet down on the lay of the formation—37½°. The skips used hold 2½ tons of rock, except in No. 4, Calumet shaft, where the skips are larger, hold five or six tons.

The South Hecla proves to be surprisingly rich; in places it is 20 to 30 feet wide, and all good. The wider portions are the richest.

The three new hoisting engines for 1, 2 and 3 Hecla shafts are called Gratiot, Houghton and Seneca. The cylinders are 18″x48″ and 27¾x90″.

Shafts 3 and 4, Calumet, are to the 39th level, No. 1 to 27th, No. 2 to 26th level, and No. 5 is 42 feet below the 34th. The Hecla shafts are all to the 39th level.

In No. 5 shaft in 33d level they drifted north 250 feet, 150 feet of which was good ground. In the 34th the ground has proved first-rate as far as they went north and all the way south to No. 4 shaft. Above the 33d the ground between No. 4 and No. 5 was poor, thence in 33d and in 34th it is first rate.

This feature is an encouraging one for the Centennial and Tamarack jr. The vein is 13 feet wide and all good.

The only shafts that have produced any copper since November 30, last, are 11 and 12, and the double shafts 9 and 10, Black Hills mine. Fortunately this mine was well opened up when the first fire occurred and the company has been able to keep up its product.

The company has 3,000 names on its pay roll; ordinarily it has 4,000.

An important undertaking by the Calumet and Hecla is the sinking of a downright shaft, which was begun near the close of 1888. It is located in the village of Red Jacket, and is named the Whitney, after the general manager. Its location is in the S. W. ¼ N. W. ¼ of section 14, near the north line of the 40 acres and at about 400 feet east of the west line. It is in the vertical plane through the axis of No. 4 shaft. Its depth will be, to reach the conglomerate, 3,325 feet. It is a 6-compartment shaft, 14′x22½′. Why it should be made so large I don't see. A much smaller shaft will hoist all the rock that can be got to it. Thus there are five vertical shafts in progress in the vicinity of Red Jacket to reach the Calumet and Hecla conglomerate, besides the two already down, and the Whitney will perhaps be the shallowest of any.

An important transaction by the company, recently, was the purchase of the S. W. ¼ of the S. W. ¼ of section 14—40 acres, known as the Mettalline, for $500,000. By reference to the map its importance will be readily seen.

At the stamp mill they are not able to work full capacity owing to the fire in the mine. There are 11 heads in the Calumet mill and 7 in Hecla, all Leavitt improved. They are experimenting with solid iron bottom to stamp head, and express the intention of adopting this change.

In the great boiler house at the mills are ten boilers, 90″x35′. A new pumping engine will be added; also an additional sand wheel 53 feet diameter. The one now in use is 43 feet. The new one will be in same building with the other. The weight of the new wheel, it is said, will be 400,000 pounds, that

is with its load of sand and water. Its estimated capacity is 30,000,000 gallons of water and 2,000 tons of sand each 24 hours. The Calumet mill will have 374 jigs and 44 slime tables, while the Hecla mill has 238 jigs and 28 slime tables.

The new pump will be called the Michigan. An 185-lb. pressure boiler has been placed at the water-works. The smelting works of the company also at Lake Linden, not far from the stamp mills, are admirably arranged.

Total number of tons of rock stamped in 1887 654,055
Total number of tons of rock stamped in 1888 763,728

The company returned to the shareholders in 1888, $20 per share, making a total to July, 1888, of $32,350,000.

Table of product of Calumet and Hecla mine:

Year.	Tons.	Pounds.	Year.	Tons.	Pounds.
1867	657	1,173	1878	12,626	1,128
1868	2,549	375	1879	13,135	943
1869	6,157	1,771	1880	15,837	1,239
1870	7,030	1,584	1881	15,680	781
1871	8,111	590	1882	16,026	1,528
1872	8,081	183	1883	16,562	1,045
1873	9,424	265	1884	20,236	1,585
1874	10,062	1,225	1885	23,623	1,990
1875	10,736	1,954	1886	25,259	220
1876	10,845	732	1887	23,008	123
1877	11,284	468	1888	25,147	1,721
Total				299,104	1,281

Mr. J. N. Wright, Superintendent, Calumet, Mich.; Alex. Agassiz, President, Boston, Mass.

The following table is of value, since it shows the amount of rock stamped each year and the percentage of its yield in refined copper, as given to me from the company's books:

Year.	Tons of rock stamped.	Yield per cent. of ingot copper.	Year.	Tons of rock stamped.	Yield per cent. of ingot copper.
1875	249,704	4.3	1882	344,182	4.59
1876	259,935	4.37	1883	372,570	4.45
1877	247,935	4.55	1884	435,352	4.63
1878	271,000	4.66	1885	535,820	4.32
1879	284,715	4.61	1886	598,522	4.22
1880	334,343	4.75	1887	654,055	3.52
1881	340,080	4 61	1888	763,728	3.28½

The lower percentage of the last two years is due to the fact that most of the rock has come from the Black Hills mine.

THE CENTENNIAL MINING CO.

has resumed operations. The company owns Sec. 12, joining the Calumet and Hecla on the north and crossed by the conglomerate and other belts. many years ago, the Schoolcraft Co., the predecessor of the Centennial, worked quite extensively for the times, in the conglomerate, but found it poor. The Centennial Co. subsequently opened a mine in the Osceola amygdaloid, but the undertaking did not prove successful.

Recently a reorganization has been effected, the sum of $400,000 raised, and preparations made for sinking a deep shaft. The work is under the charge of Capt. J. Vivian, and was begun Dec. 22, 1888. The plan is to go down with No. 4 shaft, which is 700 feet deep, on the dip of the formation—38°—100 feet further, and then cross-cut east to the Osceola amygdaloid, and explore and work that belt somewhat.

But the chief purpose is to sink No. 3 shaft in the conglomerate until it enters good copper ground. No. 3 is the most southerly shaft, and it is believed that the unexplored ground between it and No. 5 Calumet shaft may contain a rich "shoot of copper," which will be cut in No. 3, by sinking it. Also, in the bottom of No. 5, the conglomerate, 150 feet north of the shaft, is 13 feet wide and very rich, in the 33d level, while above, it does not hold copper. It is a reasonable supposition that this shoot of copper, as it lies very flat, extends into the Centennial ground. Anyhow, the only way to find out, is to sink the shaft, and if there is a rich shoot of copper they must intercept it.

In all, in the old Schoolcraft mine, in the conglomerate, there are five shafts, numbered from the south. No. 1 is to the ledge; No. 2 to 1st level, 120 feet deep, and 330 feet north of No. 1; No. 3, 450 feet deep, to the 5th

level, and is 375 feet north of No. 2; No. 4 is 700 feet deep—90′ below the 5th level—570 feet north of No. 3; No 5 is 360 feet north of No. 4, and is simply a little way into the ledge. It is in wet ground, and is said to have shown some copper.

Capt. Vivian expresses the intention of continuing a drift, which is already 430 feet north of No. 4, the whole length of the property. He wants to explore the surface. He purposes, I believe, to put in a Ball head into the old stamp mill, and to produce enough rock to keep it going.

Capt. Vivian is putting the old machinery in order to do all the exploring, etc., contemplated.

There are sufficient dwellings, buildings, machinery, etc., for present needs. At the time of my visit, the force employed was 50 men, and they were chiefly engaged in freeing the mine of water.

The officers are: H. A. Stevens, Pres.; D. L. Demmon, Sec. and Treas., Boston; Johnson Vivian, Agt.; James Taylor, Mining Capt.

THE WOLVERINE MINE,

it was announced some time ago, would be worked by Mr. N. F. Leopold, of Chicago, who, it was said, had leased the mine. But I visited the property recently, and discovered no indications of coming activity. Everything about the mine has gone to ruin. Destructive forces, human and otherwise, have been busily engaged.

There are two shafts—No. 1, 500 feet deep, to the 6th level, and No. 2 to the 5th. A map of the mine and fuller description will be found in report of 1882. James Wall, Calumet, Mich., I think, represents the property. It was reported that Mr. Leopold would pay ten per cent royalty, with an option to purchase, running two years, at $90,000.

The mine is in the N. ½ N. E. ¼ of Sec. 7, 56, 32 adjoining.

THE KEARSARGE,

an old organization, or at least the name has been applied to this property a long time. It has come to the front as a producing mine, and has been, lately, yielding rock that holds a good percentage of copper. It is a very peculiar looking amygdaloid, dirty brown color, and the copper contained looks like the rock surrounding it. It is bunchy, like all amygdaloids, that is, they found pockets that yielded two to three per cent of copper, but now, in the bottom, it is very poor, or was so about the first of March. The shafts, 1 and 2, are to the 6th and 8th levels, respectively, 470 feet apart, but the

best ground has been above the 2d level. Some pretty fair copper rock in vicinity of No. 2 shaft in the 4th and 5th levels, none at all in 7th and 8th. The shafts are connected in all the levels, but not much stoping has been done. The shafts are, No. 1, 720 feet deep, No. 2, 800 feet deep; or if same datum is taken, No. 2 will be 820 feet deep. They incline 40° and 41½°, and are now in the hanging wall, though formerly in the lode. The deposit is a very irregular one; it twists about exceedingly, and is thus difficult to follow. One important fact is worthy of note. The mine, before the end of the year, will have yielded enough copper to return all that has been expended, so that the stockholders will be nothing out pecuniarily. The officers are, Charles Van Brunt, President; A. C. Bigelow, Secretary and Treasurer; John Daniell, Agent; J. D. Hoskins, Mining Captain and Superintendent. A branch of the Calumet and Hecla R. R. extends to the mine, and the rock is sent to the Osceola mill to be treated, using one stamp. The company began to produce copper last August.

The following is a summary of the company's report:

The operations of the Kearsarge Copper Mining company in 1888 show this general result:

Mineral product 946,876 pounds, yielding at 86.83 per cent 829,185 pounds refined copper, sold for		$137,609 71
Interest receipts		1,458 65
Assets Jan. 1, 1888		56,479 56
Total		$195,547 92
Expenditures.		
Operating	$72,554 60	
Smelting, freight, etc.	10,579 43	
Total	$83,134 03	
In mine plant	18,173 79	
		101,307 82
Assets, Jan. 1, 1889		$94,240 10
Assets.		
Cash at Boston		$7,303 75
Cash at mine		562 68
Supplies at mine		1,630 73
Bills receivable		44,449 75
250 shares		25,000 00
Copper on hand, 560,885 pounds		43,046 03
Total		$122,082 94
Liabilities.		
Drafts outstanding		$11,536 68
Accounts payable		16,312 16
Total		$27,842 84
Balance of assets Jan. 1, 1889		$94,240

Superintendent's Report.

Opechee, *February 12, 1889.*

To the President and Directors Kearsarge Mining Co.:

Gentlemen—The following is a report of our operations for 1888.

Development work underground and construction work at surface engaged our attention for more than half the year. There was more delay than we anticipated in getting our rock house ready for handling rock. We sent the first rock to Osceola mill August 15th, making the first product of importance that month. A few tons, coming from the openings principally, had been previously sent to the smelting works. In figuring the yield from the mine, no account has been taken of rock or copper produced prior to commencing regular production. The following figures show the whole situation for the year:

Produced prior to stamping	7,632 lbs. mineral.	5,800 lbs. ingot.
" after stamping	949,096 lbs. "	823,385 lbs. "
	957,628 lbs. mineral,	829,185 lbs. "

Yield of mineral was 86.6 per cent ingot, probably higher than any other mine in the region. Since we commenced stamping we have handled, altogether, 24,250 tons of rock, the equivalent of 1,347 fathoms of ground, the yield of ingot being 611 lbs. per fathom, or about 34 lbs. per ton of rock handled. It is needless to remark that with such a yield we can produce copper very cheaply.

The underground openings for the year foot up as follows:

Shafts	239.6 feet.
Winzes and rises	628.1 "
Levels and cross-cuts	1,691.7 "
	2,559.4 feet.

Of the drivage, 250 feet would be cross cuts driven from shafts to reach the lode, and through the lode to test its value.

No. 1 shaft has been sunk for the year 52.2 feet It is now 10 feet below 6th level, and 660 feet deep. No. 2, shaft sunk 187.4 feet. This is now down to 8th level and about 790 feet from the surface.

Drifting at the several levels is as follows:

1st level	88.1 feet.
3d "	26.3 "
4th "	225.7 "
5th "	330.2 "
6th "	807.0 "
7th "	214.4 "
Total	1,691.7 feet.

From all we see during the past year there is no doubt but that the two amygdaloids referred to in last report are separate lodes, each containing its course. The eastern one, on which most of our work is done, continues as irregular in course in the deeper levels as was before noted. The number of crossings and faults that we encounter, which invariably throw the lode, are in excess of anything seen in the district, and have much to do with the disturbed character of the ground we meet with. The influence of some of these should grow less as we get deeper.

As we find opportunity, we keep testing points of promise in the different levels with varying success, but on a whole satisfactory results. Today, so far as I can judge, we have as much copper ground in sight as was counted on when we began stoping. I would like to speak more confidently of our late opening work, but it seems to me that we must get below or beyond the disturbed and broken ground that we have been developing at 6th and 7th levels before we can count on anything really good in the bottom of the mine. Ours is not an unusual experience, for most of the mines of the district have had their poor streaks. We have quite a reserve of copper ground, and it must be expected that we shall use all diligence to find more before this is exhausted. The lode makes very rich ground, and if only a small proportion of what we shall open proves good, we can not only maintain our position, but better it in matter of production.

Rock house work is very cheaply done, the character of the rock making but little wear and tear. Transportation of rock by the H. & C. R. R. costs us 20 cents per ton. Service to date has been quite satisfactory.

Stamping 19,425 tons of rock at Osceola mill has cost us 50 cents per ton.

The principal construction work of the year was the erection of rock house, floor space 40x65 feet, at No. 1 shaft, and the connecting trestle with No. 2 shaft. Later we put in a new boiler, and have built 11 log dwellings for employés.

Our business has run very smoothly, the assisting officers being anxious to secure success.

With this you will receive mine plans and details of expenses, which I trust will be satisfactory.

Very respectfully yours,

JOHN DANIELL, *Superintendent.*

The Kearsarge is the last mine in Houghton county. About a mile further north we cross the line into Keweenaw county, and come to the

ALLOUEZ MINE,

which has been the scene of a good deal of renovating work, lately, greatly to the improvement in appearance of the location and to the advantage of the mine. The dwellings have been repaired and repainted; a new "dry" built; the hoisting machinery relined at No. 1; boilers repaired; new stone engine house built at No. 1 shaft 44′x40′ and 26′ high, built up from the solid ledge; two engines, each 24″x48″; drum 12′ diam., with arrangement for taking up the rope attached to counter balance. I have been at the mine and have taken full notes, but since my visit the company has issued a very full report, and on looking it over I think it covers all that need be said.

Allouez Mining Company's Annual Report.

The directors present the following report of the operations during the year 1888:

Receipts.

314,198 pounds copper (product of November and December)		$43,092 57
Assessment No. 19		79,674 00
Balance of interest account		744 80
		$123,511 37

Expenditure.

Running expenses at mine (November and December)		$37,490 35	
Repair account		86,104 39	
Construction account		22,755 85	
Purchase of store building		2,000 00	
Tax on copper of 1887		331 88	
Expenditure at mine		$148,682 47	
Freight	$1,439 83		
Smelting	3,451 46		
Brokerage	226 42		
Insurance	46 47		
Expense	3,128 41		
		8,292 59	
Total expenditure			156,975 06
Excess of expenditure over receipts			$33,463 69
The balance brought forward from 1887 was			48,497 97
Leaving balance Dec. 31, 1888, of			$15,034 28

as shown in detail in the annexed statement of assets and liabilities.

The operations during the past year have been mainly confined to renovating and making additions to the plant, and getting the mine into condition for regular work.

The amount of work necessary to be done has far exceeded expectations; the dilapidated condition of the machinery and buildings, owing to neglect of repairs by the late lessees, rendering a large expenditure unavoidable in order to fit the machinery for economical work and the buildings and dwellings for occupancy.

In prosecuting the underground work it was found that the two working shafts were in such bad condition that retimbering from top to bottom in a thorough manner became necessary, and that they needed some enlargements, in order to admit of hoisting larger "skips" or rock cars that were used when these shafts were started. In addition to the cost of this work, the prosecution of the openings in the mine was seriously retarded thereby on account of the necessary suspension of hoisting while the shafts were under repairs.

It was found necessary to remove from No. 1 shaft the pumping and hoisting plant heretofore employed at that point. Having been originally of poor construction, it had become only fit for the "scrap pile." As this shaft will command the most productive part of the mine, it was determined to equip it with a modern and effective plant of sufficient capacity to perform all the work required for many years. This will soon be in operation and be of material service in keeping the mill supplied with rock.

ALLOUEZ MINE—LON

Scale: 300

DINAL SECTION, 1889.

an inch.

The cost of repairs and other work is shown in detail in our agent's statement herewith submitted. While amounting in the aggregate to a larger sum than could have been anticipated, yet we can see no way in which any part of it could have been avoided. If a mine of this character is to be made profitable, a large quantity of material must be mined and treated at low cost, and this cannot be done without proper facilities. These include not only an equipment of adequate capacity, but sufficient extent of openings underground to admit of a proper selection of "pay ground." While we have not yet arrived at the point where we can make selection to the best advantage, yet the openings are being pushed as rapidly as possible, and we expect to have, in a few months, the mine well opened and everything in good working order.

The stamp mill was started November 1, but has not yet been supplied to quite its full capacity. The lessees having cleaned out everything in sight that carried copper, the earlier openings were unavoidably in poor ground, and. even with the best selection we could make, the yield of copper has been much lower than the average of former years and that which we look for in a short time, as we penetrate further into the better ground now opening in the lower levels (17th and 18th) which are showing at this time especially promising ground.

The store buildings on our mine location, heretofore owned and occupied by Watson & Walls as a country store, having fallen into the hands of their creditors, were purchased by us for the sum of $2,000. A stock of provisions and general merchandise must be maintained in proximity to the mine, and the possession of these buildings gives us the opportunity of securing supplies for our work people, as well as a rental in payment for the privilege of selling the goods, that will soon reimburse us for the outlay.

For further information we refer to the report of our agent at the mine, and the statements herewith submitted.

By order of directors.

JOHN STANTON, *Treasurer.*

ASSETS AND LIABILITIES OF ALLOUEZ MINING CO., DECEMBER 31, 1888.

Assets.

Cash	$5,700 18
Copper on hand	23,134 29
	$28,834 47
At mine	27,219 02
Total assets	$56,053 49
Liabilities	41,019 21
Balance of Assets	$15,034 28

STATEMENT OF EXPENDITURE AT ALLOUEZ MINE FOR THE YEAR 1888.

Repairs to Buildings, Machinery, Etc., and Preliminary Work.

Underground Work	$10,419 60
Fuel, timber, rails, etc	27,808 17
	$38,227 77
Shaft house and connections	3,345 53

No. 2—Engine house	$7,191 02
Rock house	3,546 30
Dry house	614 03
Railroad	5,412 74
Stamp mill	11,127 99
Dwelling houses	5,082 39
Dam on Hill creek	2,403 73
General surface expenses	5,177 37
Expense account	5,570 22
	$87,698 89
Less rents, 10 months	1,594 50
Total charged to repairs	$86,104 39

Construction Account

Machine shop	$4,881 70
Pump and air pipes	1,273 99
No. 2, hoisting engine (additions)	4,299 70
No. 1, hoisting engine	15,230 86
Covering boilers	750 00
Dry house, stamp pipe	319 60
Total construction account	$22,755 85
Building account, store	2,000 00

Running Expenses, November and December.

Mining	$9,166 90
Power drills	2,655 18
Mining captains and other labor, etc.	9,323 66
	$21,145 74
Less profits on supplies	2,240 00
Net Total	$18,905 74
Hoisting	2,980 48
Selecting and breaking rock	3,565 34
Railroad	1,263 05
Surface expense	674 57
Transportation to smelting works	519 05
Expense account, less credits	1,160 30
Stamp mill	9,156 32
	$38,224 85
Less rents in November and December	734 50
Total running expenses in November and December	$37,490 35

General Summary of Expenditures for 1888.

Running expenses, November and December	$37,490 35
Repairs, etc.	86,104 39
Construction	22,755 85
Buildings	2,000 00
State tax on copper produced in 1887	331 88
	$148,682 47

Agent's Report.

Allouez Mich., *February 20, 1889.*

Upon resumption of work by the company, in a limited way, after the mine had been in posession of a party of tributers for nearly three years, it became necessary to open new ground as speedily as circumstances would permit, no available stoping ground having been left to us except a small block in the back of the 16th level, south of No. 2 shaft.

No. 2 shaft has been sunk from the 16th to to the 18th level, a depth of 201.6 feet in an unproductive lode, not unexpected, however, the ground in proximity to the shaft having been poor in the level above.

The ground broken through the year was:

Sinking shafts	244.6 feet.
Driving levels	1090.3 feet.
Stoping	1419.15 cubic fathoms

Both No. 1 and 2 shafts were found in bad working condition, and were both mostly re-timbered and new-tracked with steel rails. They are now in first-class working order.

The whole surface plant with hardly any exception, and all our dwelling houses, needed a large line of repairs, and in some cases rebuilding. The time required for it extended into October, and in some cases to the end of the year. As a result, necessarily, considerable money had to be expended to put the plant again in good working order. I may say that this has been accomplished, and when the new hoisting machinery for No. 1 shaft, now on the ground and in course of erection in a well-built stone building, is set to work, it will give us easier and first-class hoisting facilities. The machine is provided with 24x48 inch cylinders, will be first motion, and have counter-balance car to offset the weight of skip. It will prove an economical engine.

As stated before, fully ten months of the year were wholly devoted to a general overhauling of the plant and to the prosecution of such openings underground as we were able to do without any hoisting machinery in shape to use. Before shutting down the mine on failure of lessees, one of the boilers at the hoisting works exploded, completely demolishing it and the boiler house. The three remaining boilers were totally unfit for further duty without extensive repairs. Such repairs to two of them, together with rebuilding boiler-house, repairing engine and foundation and adding two new boilers, consumed most of the past summer. The hoisting plant is now in very good shape, doing better duty than ever before.

The result of the two months productive operations did not fully meet our expectations. The cause is mainly attributable to the low percentage of rock stamped, of which a large part came from the openings, and to an insufficient supply of rock for the mill for full duty. It will be borne in mind that the openings were not extensive enough to enable us to obtain good results at the outset. In addition, some of them, viz., at the 17th and 18th levels were in unproductive ground up to the end of the year.

The oulook for the present year is quite encouraging. As we gain in our underground openings results will improve. I confidently look for a larger output in the near future. At the 17th level we have every reason to expect the rich stoping ground now available, continuous to the 16th level and for a length of at least 400 feet south, although it may not produce for its entire length the grade of heavy copper now exposed. The 8th level

will soon penetrate the same run of ground, and we confidently expect to find it well mineralized.

The ground south of No. 1 shaft holds out good promise for the future. The drifts at the 6th and 8th levels show better copper courses today than at any time since the resumption of operations. In a short time the skip track will be completed for No. 1 shaft. It must be our aim to extend new openings with all possible diligence. The character of our lode is such that only with a liberal amount of stoping ground to choose from can the best results be obtained.

The breach in our dam on "Hill's Creek" (occasioned by the sudden spring flood in 1885), has been substantially repaired. The supply of water for our mill from the two available streams has been ample to date, and we have not been called upon to resort to pumping. The tables of cost prepared by the clerk are in your hands and will show in detail the cost and result of operations during the past year.

I am indebted to my associate officers for the faithful performance of their share of the year's work.

Yours respectfully,

FRED. SMITH, *Agent.*

Table of Products.

Year.	Tons.	Pounds.	Year.	Tons.	Pounds.
1869	1	1,575	1881	736	1,007
1873	10	1,163	1882	841	1,557
1874	504	130	1883	875	1,337
1875	692	1,574	1884	964	174
1876	780	1,785	1885	1,085	476
1877	650	479	1886	862	1,468
1878	565	1,146	1887	442	1,010
1879	715	1,452	1888	157	198
1880	658	471			
Total				10,546	931

In Keweenaw county only two mines have been worked the past year besides the Allouez. The Cliff remains idle, as does also the Phœnix, and the next in order is the

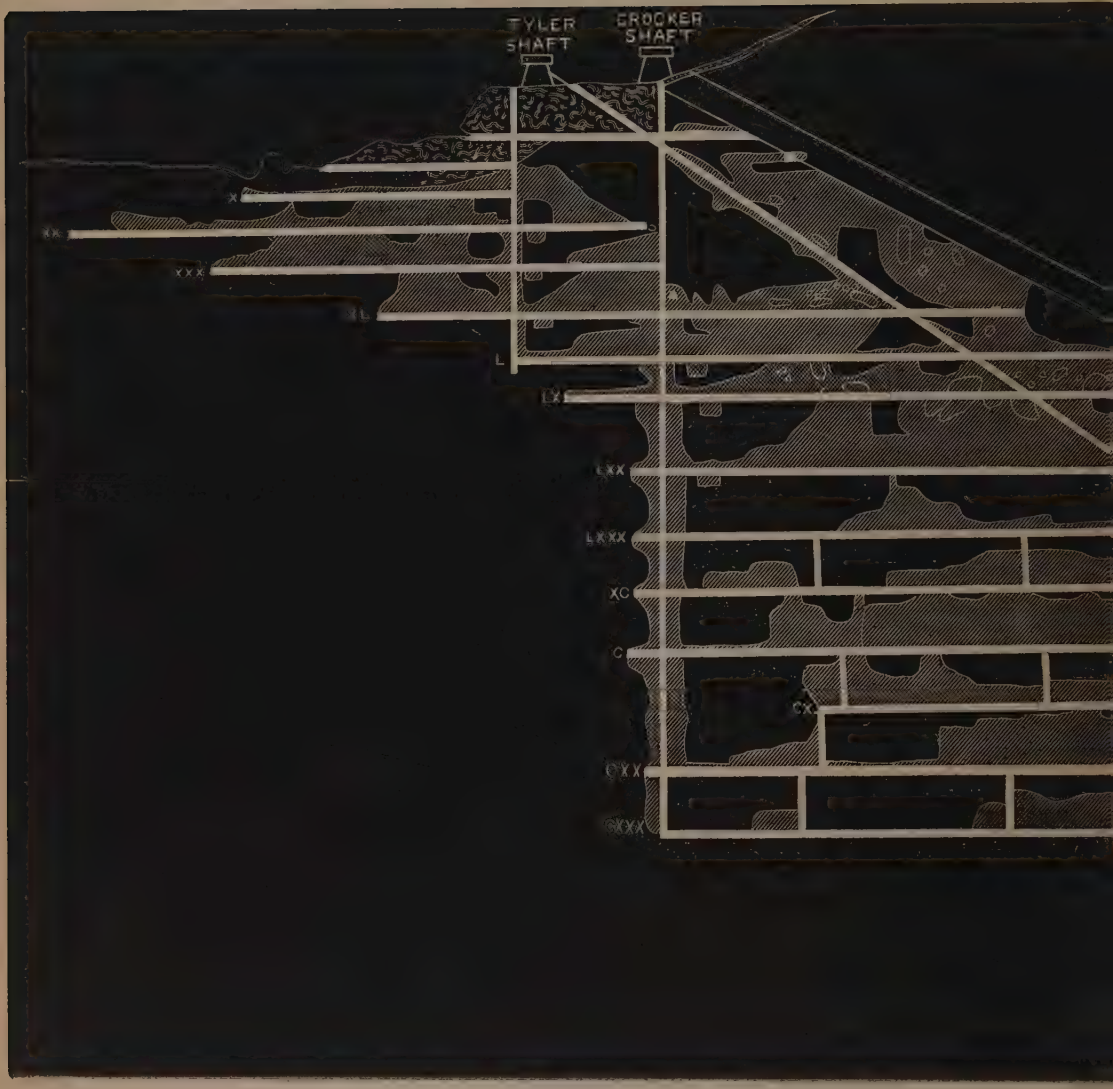
CENTRAL MINE,

which, notwithstanding its great depth, and the fact that it is the only fissure vein copper mine worked in the State, is still operated at a profit.

The mine is 2,700 feet deep, vertically down. I descended to the bottom recently with Capt. Bennett, and felt disappointed with the outlook. The mine is so different from the others, in amygdaloid and conglomerate belts. Sometimes the vein is a mere trace; sometimes showing no signs of copper; in portions affording only stamp rock, and occasionally yielding masses and

LONGITUDINAL SECTION

Scale: 30

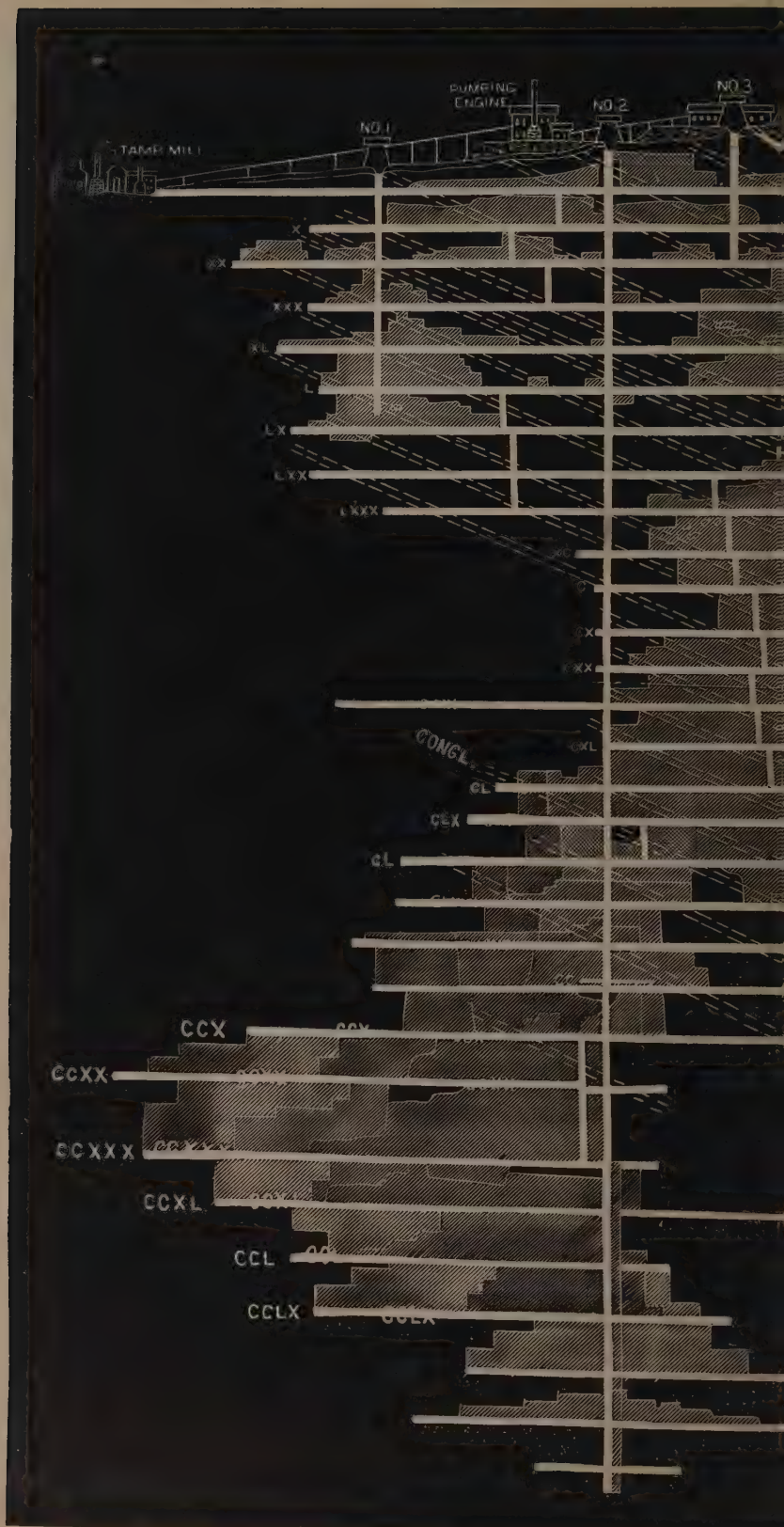


THE PHŒNIX MINE, 1889.

o an inch.

LONGITUDINAL SECTION

Scale



HE CENTRAL MINE, JAN. 1, 1889.

eet to an inch.

barrel work richly. To look over this well-built, comfortable village of 1,200 and more souls, with its churches and fine graded school building, etc., and realize that the entire basis of support is the small copper vein now worked at a depth of more than half a mile; that all the rock and timber coming out and going into the mine must traverse the one single skip shaft, might lead one to think that the support was a precarious one. But however unpromising the mine may look to one who descends into it, as the years come around it seems to hold its own and to give to its owners their annual dividend, and to the people of the location an assured and comfortable support.

Like nearly all mines, there is a good deal of necessary dead work—that is the greater part of the ground opened is worthless—but it must be tested in order to find the little that is good. The vein dips east, and the shaft keeps in the vein for a portion of the way from the surface down, after which it descends vertically, making a crook in the shaft. The drift east towards the Northwestern vein, 1,700 feet away, advances 45 feet per month. It follows the Calumet and Hecla conglomerate. The shaft is 6′x12′. Capt. Dunston wants to straighten it It needs to be overhauled. With the new machinery they can hoist very rapidly. The hoisting plant is not excelled by any in the copper region. It was built by E P. Allis & Co., and is provided with automatic safety cut off, so that if the engineer fails in his duty the skip will only ascend to the proper point. The disposition of this trap rock to swell and expand is noticeable in the Central mine. Even where the walls stand vertical, they will swell so as to crush the large stull timbers that span the space between them. When the vein is wide the rock tends te drop out from between the walls. Just before my visit to the mine a man was killed in this way—vein rock fell on him. The Central mine is in a fissure vein that crosses the formation at nearly right angles, and dips away slightly from the vertical, so that in the bottom level—29th—the cross cut from the shaft to the vein is 220 feet.

I took full notes at the mine, but Capt. Dunstan's report covers everything necessary to mention, and I add that in full.

Annual Report of the Central Mining Company.

The directors present the following statement of the operations during the year 1888:

The production of mineral was 1,142 795-2000 tons, which yielded about 79 53-100 per cent, or 1,817,023 pounds of refined copper.

The following is a summary of the year's business:

Production.

1,817,023 lbs. copper, at 14 8-10 cents		$268,911 48
Silver		309 40
		$269,220 88
Add interest received		4,981 80
		$274,202 68

Costs.

Working expenses at mine	$155,244 11	
Construction account at mine	8,679 68	
Smelting, freight, and all other expenses	32,681 76	
Making the total expenses		196,605 55
And showing a net profit in 1888 of		$77,597 13
There has also been expended for purchase of "Eagle river" property 940 acres	$7,060 24	
Less amount credited real estate for stumpage on "Northwestern" and "Madison" lands	3,480 71	
		3,579 53
Making the net increase in assets		$74,017 60
The surplus from 1887, after payment of dividend, was	$221,486 19	
Less dividend paid August 1, 1888	30,000 00	
		191,486 19
Making the net surplus, December 31, 1888		$265,503 79

As shown in detail in the annexed statement of assets and liabilities, and out of which a dividend of two dollars per share ($40,000) was paid February 1st, 1889: making a total of $70,000 in dividends on the year's business.

The production shows a small decrease from that of the previous year, and the increase of profits is due to the better prices obtained for our copper.

For further information we refer to our agent's report and the financial statements herewith submitted.

JOSEPH E. GAY,
WM. C. STURGES,
ROBERT PORTERFIELD,
JOHN STANTON,
Directors.

NEW YORK, March 25, 1889.

ASSETS AND LIABILITIES, DECEMBER 31, 1888, EXCLUSIVE OF REAL ESTATE AND MINE PLANT.

Assets.

Cash on hand	$24,772 41
Loans	142,040 00
Silver on hand	309 40
Copper on hand, sold	54,725 08
Accounts receivable	3,058 48
	$224,905,37

At Mine.

Cash	$4,542 59	
Merchandise in store	28,701 10	
Supplies	36,404 08	
		$69,647 77
		$294,553 14

Liabilities.

Agent's drafts	$2,326 28	
Indebtedness at mine	17,216 68	
Accounts payable	9,506 39	
		29,049 35
Balance of assets		$265,503 79
Less dividend, February 1, 1889, of		40,000 00

SUMMARY OF RECEIPTS AND EXPENDITURES OF CENTRAL MINING COMPANY, FROM ITS ORGANIZATION TO DECEMBER 31, 1888.

Receipts.

Capital stock paid in	$100,000 00
Copper sold, including silver	8,673,494 31
Profit on timber sold	79,011 75
Total receipts	$8,852,506 06

Expenditures.

Net expenditure for mining operations, buildings and machinery, smelting and marketing copper, and incidental expenses	$6,672,691 75	
Net cost of "Madison," "Northwestern," and "Eagle river" lands	24,310 52	
Total expenditures		$6,697,002 27
Balance of receipts		$2,155,503 79
Deduct dividends paid		1,890,000 00
Net surplus December 31, 1888		$265,503 79

(As shown in statement of assets and liabilities on preceding page.)

AGENT'S REPORT.

KEWEENAW, CO., MICH., *January 1, 1889.*

JOHN STANTON, ESQ., *Secretary and Treasurer, New York:*

DEAR SIR—The following report of operations at our mine during the year 1888 is respectfully submitted:

Ground Broken.

Sinking in shafts and winzes, 224½ feet, average cost	$20 25
Drifting on vein and cross-cuts, 1,637 2-12 feet, average cost	7 46
Stoping on vein, 2,361 16-36 sup. fathoms, average cost	13 44

Stoping on plats, etc., 400 cubic fathoms.

The total amount of ground broken in openings and stopes is 3,346 cubic fathoms.

Production.

930 bbls. stamp copper, weighing	1,266,150 lbs.
99 hhds. barrel copper, weighing	351,010 lbs.
225 masses copper, weighing	667,635 lbs.
Total	2,284,795 lbs.
Or 1,142 795-2000 tons.	
Average yield of mineral per fathom of ground broken	683 lbs.
Average yield of ingot per fathom of ground broken	543 lbs.

Expenditure at Mine.

The total expenditure for the year is as follows:

Mining and surface expenses	$140,878 47
Stamp mill expenses	15,418 53
Taxes	3,306 65
Construction account	8,679 68
	$168,283 33
Less rents received	4,359 54
Total expenses	$163,923 79

SINKING.

No. 2 shaft has been sunk from the 28th to the 29th level, and a cross-cut driven from the shaft to the vein about 200 feet. A winze has been sunk from the 28th to the 29th level. While sinking this winze the vein in places has shown good copper, but at the bottom it is small and poor. We are now sinking both the shaft and winze to the 30th level.

DRIFTING.

At the 29th level we have driven both north and south only a short distance, and thus far the vein has shown but very little copper, but I am looking for an improvement in these drifts every day, as in the bottom of the level above there is a good vein.

The 28th level is also being driven both north and south of No. 2 shaft. These drifts are looking very well at present. In the south drift the vein is about four feet wide, producing good stamp and barrel copper. The north drift is producing good stamp rock, but not so much of the heavy grade copper. These drifts are now extended north 313½ feet, and south 276⅔ feet.

We have extended the 27th level south of No. 2 shaft 61 7-12 feet, which has opened up some good ground, but at present it is poor.

The following levels have been extended south of No. 2 shaft as follows: 22d level, 118 10-12 feet; 23d level, 101 feet; 25th level, 22 8-12 feet, and 26th level, 23½ feet.

STOPING.

Our stopes the past year have not produced as well as we expected from their appearance in the early part of the year, and at the present time are not looking as well as we would like to see them, but this has always been characteristic of the "Central" vein. Most of the stopes are yielding good stamp rock, but have fallen off in mass and barrel work, but we have a good show of mass copper in bottom of 28th level, and as the stopes are worked up from the 29th level, I feel confident of striking good ground in these stopes in the near future. The greater portion of our mass and barrel copper

came from the stopes in the back of the 28th level, north and south. At the present time we are not cutting any masses, nor have we any large ones in sight.

We are driving a cross-cut at the 19th level from No. 4 shaft east, toward the "Northwestern." It is now in 352 feet from the shaft. We are driving it on a belt of conglomerate, supposed to be the "Calumet" lode, but it has so far shown no copper, but the main object is to cut the transverse veins passing through this property and the "Northwestern."

CONSTRUCTION.

We have expended considerable this year for construction. We have put in a "man engine" in No. 2 shaft from the 21st to the 26th level, at a cost of $4,025, and built a new store and warehouse which cost $3,200, and one new dwelling house costing $600, besides making minor improvements and repairs to old dwelling houses. We are using the old store for a carpenter and machine shop, which answers well for the purpose.

Respectfully yours,

JAMES DUNSTAN. *Agent.*

Table showing Product of Central Mine—refined Copper.

Year.	Tons.	Pounds.	Year.	Tons.	Pounds.
1856	32	403	1873	751	1,117
1857			1874	870	900
1858	71	1,011	1875	733	952
1859	84	312	1876	1,080	1,400
1860	125	1,370	1877	997	1,640
1861	70	139	1878	945	1,013
1862	133	1,972	1879	899	1,495
1863	278	1,548	1880	1,013	78
1864	381	1,855	1881	709	465
1865	346	1,200	1882	676	1,595
1866	571	1,842	1883	634	556
1867	678	745	1884	723	747
1868	1,353	1,827	1885	1,078	1,408
1869	903	1,801	1986	1,256	886
1870	663	1,156	1887	1,099	1,133
1871	716	662	1888	908	717
1872	623	56			
Total				20,355	1,890

John Dunstan, Agent; Samuel Bennett, Mining Captain; J. F. Robert, Clerk; John Stanton, Secretary and Treasurer, New York.

THE COPPER FALLS MINE

is situated opposite the Central mine, on the other side of the range. The mine itself looks about as usual, but the development work is more advanced

than it has been sometimes, and in many things there is improvement. Capt. Moyle, the agent, deserves much credit for the manner in which he has pushed the work.

The mine is entered by an adit from the north driven on a fissure vein on what is called the ninth level. After reaching the ash-bed, which is the amygdaloid deposit that is mined, the locomotive turns west, in which direction the mine has been opened for a distance of upwards of 1,400 feet. Off to the west are two underground shafts, extending above and below the adit level. Each shaft is provided with a double track, so that a descending car helps, by its weight, to draw up another one on the parallel track. There is a hoisting plant at each shaft that supplies the additional force required. The same cars that are drawn into and out of the mine by the locomotive, also go up and down the shafts to the desired levels, and thence go to the stopes. All this I have fully described in previous reports, and only refer to it here in the most general way.

The deposit is opened a total depth of about 1,400 feet; 7 levels below the adit, and 9 above it—16 levels in all. They have gone in south on the adit vein 600 feet, where another bed is found in which they have drifted and stoped west 150 feet. Apparently, not as good as the ash-bed, though the latter is poor enough. The dip is 28° northerly, and about two-thirds of the deposit is considered as worth mining. The stamp mill was started in March, 1888, and in the succeeding ten months 103,505 tons of rock were treated, which yielded 778 tons, 1,650 lbs. of mineral, equal to about 76 per cent copper.

They sink No. 2 shaft and drift under No. 1, and rise up in it; work about 150 men—20 drills; only hoist during day shift. The inclined trestle on which cars were run up into stamp mill has been torn away, and the mouth of the tunnel and the yard track in front of the stamp mill is all covered over, as is the track leading into the car repair shop. I was at the mine on a very cold winter's day, and the agreeableness of this improvement was very noticeable. The formation is faulted in several places where veins occur, but none except the adit vein has ever been found to contain copper. The two veins west seem to be coming together, since at the 90 they are 700 feet apart, and at the 150 only 300, so Capt. Moyle states.

The 140 is opened 1,000 feet in length, and the ground is standing all the way up to the 130, for this length. The 150 is opened 400 feet in length, and they have sunk to the 160; the ash-bed is about the same at the bottom as elsewhere.

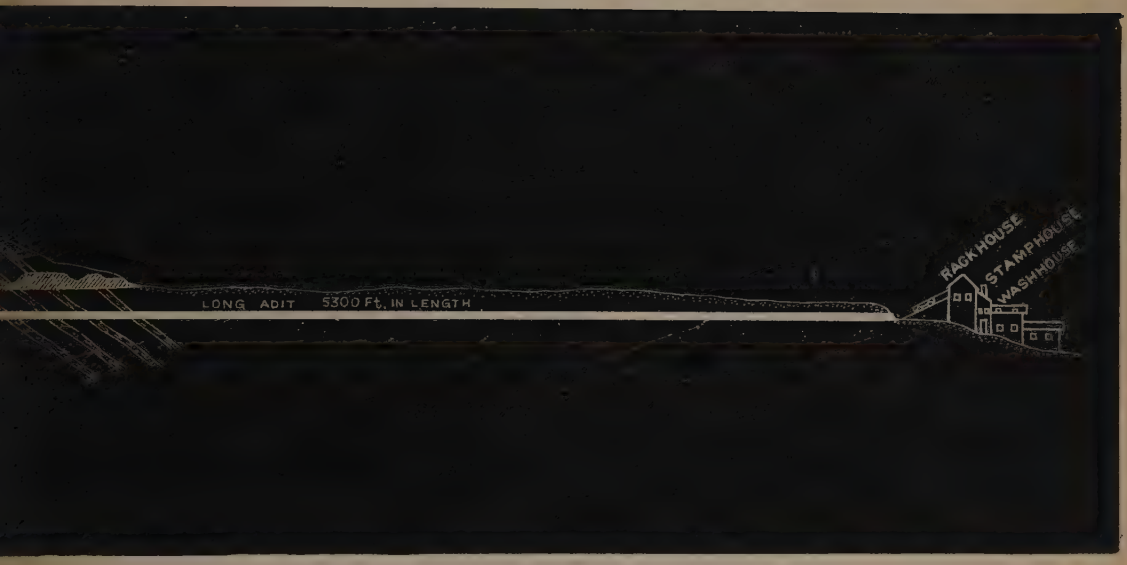
The new belt which Capt. Moyle found 610 feet south of the old workings on the main vein, was thought to be a great acquisition at first. It is harder,

LONGITUDINAL SECTION OF THE COPPE

Scal

LLS MINE IN THE OWL CREEK VEIN, 1889.

eet to an inch.



more compact than the ash-bed. On west side there is a branch vein in which Capt. Moyle is still working. It has been quite rich in places, and still affords some copper—not promising ground, however. Capt. Moyle expresses the intention to drive the adit south to the greenstone, and thus he will cut all the belts lying north of it. The remaining distance to cut is 900 feet. If a good belt is found, it will have a large depth of "back," as it is 1,500 feet to the surface on the lay of the formation now at the end of the drift. The vein itself—the Owl creek—was in earlier days one of the richest ever found in the country, and may prove productive again, so that there is a double purpose in driving this adit—to prove the vein and to prove the belts that lie north of the greenstone. Among these, yet to be found, is the Pewabic lode.

The faults, before mentioned, are throws of the formation to the north, 65 feet. They cause additional expense in the drifting in each level.

The total expenditures from March to December 31st were $134,575.76; paid for sinking, per foot, $8.50; for cutting drift stopes, $9; stoping, per cubic fathom, $12; average wages—miners, $2.00 per day; total force, men and boys, 215.

General expense account, to December 31, 1888	$3,326,287 53
Cash in mining office	85 88
Real estate	66,500 00
Machinery	162,120 75
Supplies	26,239 16
Accounts receivable	1,932 87
Extraordinary expenses	641 45
Treasurer	$3,565,533 79
Account payable—liabilities at mine	182,773 85
Total	$3,565,533 79

In the expenses is included the work on Owl creek vein, which is strictly exploring work. The amount thus expended on the Owl creek vein was $5,152.78. Subtracting this amount, leaves the mining expense cost $129,412.98, which dividing, gives the mining cost $1.25 per ton of rock. In this also is included 400 to 500 tons per month that are rejected in the stamp mill. Stamp mill cost, $29,448.31, which gives the cost per ton for treating, 28 cents. The coal has to be hauled from Eagle river with teams; also, the water has to be pumped twice, and the rock to be hoisted up into the stamp mill, 48 feet.

Construction account	$895 55
Net mining expense	134,575 76

In June, when there was plenty of water, the stamp mill cost was reduced to 24½ cents per ton, showing that if the mill had been located lower down,

on the lake, so that the increase of cost in pumping and the hoisting of the rock into the mill would have been avoided, the cost per ton for stamping would have been the lowest of any on the lake. The yield of the rock in copper is the lowest of any mine, being last year 56 per cent ingot, or 11.20 lbs. per ton. Pretty discouraging, as compared with the Calumet and Hecla conglomerate, which yields seven times as much.

Table of Product of Copper Falls Mine.

Year.	Tons.	Pounds.	Year.	Tons.	Pounds.
Previous to 1855	158		1872	260	862
1855	100		1873	643	540
1856	104	10	1874	535	359
1857	153	1,305	1875	203	1,587
1858	151	1,852	1876	8	1,488
1859	173	174	1877	5	1,950
1860	255	818	1878	5	1,790
1861	280	11	1879		
1862	299	299	1880	3	645
1863	159	1,348	1881	334	1,121
1864	179	808	1882	293	1,500
1865	235		1883	402	
1866	568	1,169	1884	445	1,168
1867	1,128	1,485	1885	575	538
1868	239	1,384	1886	689	679
1869	345	1,400	1887	270	
1870	386	990	1888	590	
1871	239	883			
Total				10,355	133

David Nevins, President, Boston, Mass.; J. H. Moyle, Superintendent, Copper Falls, Mich.

THE CONGLOMERATE MINE

remains idle. Mr. A. P. Thomas has succeeded Chas. H. Palmer as Superintendent, the latter having gone to the west and assumed charge of the Butte and Boston mine.

The Conglomerate is an exceedingly well equipped mine in all respects; but I have dwelt on all this in former reports, and I find nothing new to add. The mine, which is an old one, has yielded 2,622 tons 1,880 lbs. of copper. George H. Lewars, Secretary, Philadelphia, Pa.

Names of Copper Mining Companies.	*1855.		1855.		1856.		1857.		1858.	
	Tons.	Lbs.	Tons.	Lbs.	Tons.	Lbs.	Tons.	Lbs.	Tons.	Lbs.
[1] Adventure	34	-------	31	34	71	1,336	116	1,941	57	1,678
[3] Peninsula (Albany & Boston)	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------
[2] Allouez	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------
[3] Atlantic (South Pewabic)	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------
[1] Aztec	19	-------	1	1,467	25	1,139	14	1,361	3	251
[3] Calumet & Hecla	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------
[2] Central	-------	-------	-------	-------	32	903	-------	-------	71	1,011
[2] Cliff	3,490	-------	937	197	1,110	934	1,180	850	1,130	43
[2] Copper Falls	158	-------	100	-------	104	10	153	1,305	151	1,85
[2] Delaware	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------
[1] Evergreen Bluff	1	599	7	100	12	1,110	23	942	3	66
[3] Franklin	-------	-------	-------	-------	-------	-------	3	699	56	1,10
[3] Grand Portage	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------
[1] Hilton (Ohio)	2	-------	-------	-------	-------	705	-------	-------	-------	-------
[3] Huron	-------	-------	3	-------	12	-------	35	-------	24	-------
[1] Belt (International, Bohemian)	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------
[3] Isle Royal	58	-------	93	-------	232	1,124	210	117	178	81
[4] Kearsarge	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------
[1] Knowlton	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------
[1] Mass	-------	-------	-------	-------	-------	-------	8	228	6	-------
[1] Minesota	1,510	-------	1,040	-------	1,745	714	1,976	-------	1,901	91
[1] National	78	1,477	24	1,302	88	483	158	957	132	80
[1] Ogima	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------
[3] Osceola	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------
[2] Pennsylvania (Northwest)	555	-------	99	80	1	1,348	29	543	83	10
[3] Pewabic	-------	-------	2	301	53	1,667	118	254	208	60
[2] Phœnix	19	-------	3	-------	8	-------	17	-------	-------	-------
[3] Quincy	-------	-------	-------	-------	6	1,462	61	762	153	77
[1] Ridge	30	-------	35	631	36	1,874	29	790	39	69
[3] Centennial (Schoolcraft)	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------
[3] Sheldon & Columbia	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------
[2] St. Clair	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------
Tamarack	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------
Sundry Co.'s and tributers	1,210	1,651	547	1,222	565	1,583	629	81	385	1,43
Rolling Mill Scrap	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------
Total No. net tons and pounds	6,992	1,727	2,904	1,334	4,108	1,392	4,765	830	4,579	1,91
Total value (New York city)	$3,146,400		$1,586,160		$2,218,320		$2,382,500		$2,129,235	
Highest and lowest price	29½—16		29½—24½		29½—24½		30—20		26½—19¾	

[1] Mine in Ontonagon county.

	1859.		1860.		1861.		1862.		*1863.		1864.		1865.		18
bs.	Tons.	Lbs.	Tons.	Lbs.	Tons.	Lbs.	Tons.	Lbs.	Tons.	Lbs.	Tons.	Lbs.	Tons.	Lbs.	Tons.
,678	99	431	21	749	2	676	11	89	-------	-------	-------	1,755	3	1,491	2
----	-------	-------	-------	-------	-------	-------	3	1,982	-------	-------	3	1,000	159	160	81
---	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------
---	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	6
251	9	493	3	203	-------	-------	-------	-------	-------	-------	-------	-------	4	700	16
---	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------
,011	84	312	125	1,370	70	139	133	1,972	278	1,548	351	1,855	546	1,700	574
433	707	1,007	921	1,393	961	11	1,002	960	1,050	354	675	1,334	749	626	821
,852	173	174	255	818	280	11	229	299	159	1,348	179	808	235	-------	568
---	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	29	700	51	492	-------
665	19	811	31	1,817	49	1,187	59	1,257	70	1,446	-------	-------	187	1,213	-------
,104	116	1,211	157	1,860	783	43	733	645	639	684	605	1,335	779	1,481	819
----	-------	-------	-------	-------	-------	-------	-------	-------	177	1,793	244	1,104	241	1,592	-------
---	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	5	1,179	3	411	2
----	22	1,387	4	1,000	49	-------	69	1,305	69	206	50	1,745	238	11	-------
----	1	1,903	-------	-------	-------	-------	-------	-------	16	563	11	69	31	1,502	34
110	208	56	168	198	458	1,274	448	139	360	1,841	291	386	344	1,836	308
---	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------
----	-------	-------	-------	-------	-------	-------	11	439	42	1,451	-------	-------	98	724	-------
----	26	682	-------	-------	-------	-------	-------	-------	-------	-------	4	1,452	6	936	5
914	1,872	587	1,340	500	1,508	824	1,260	-------	838	1,500	723	-------	201	1,000	195
994	244	176	539	609	691	1,760	432	1,752	280	1,179	314	516	348	168	323
----	-------	-------	-------	-------	-------	-------	-------	-------	26	1,530	25	-------	70	990	138
---	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------
110	74	144	121	97	54	1,920	-------	-------	-------	-------	81	1,960	189	1,369	64
913	514	1,949	958	1,426	924	1,992	785	1,281	845	1,562	714	1,857	865	1,394	673
----	28	590	20	62	34	790	31	1,590	72	118	142	187	202	1,000	205
32	178	1,114	970	414	1,182	852	1,153	218	1,115	1,737	1,251	586	923	1,500	1,172
10	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	8	917	85	433	71
---	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------
---	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	36	912	66
---	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	4	815	31
---	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------
19	285	968	394	1,559	437	1,358	427	387	447	88	500	1,220	698	1,050	755
---	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------
16	4,463	1,995	6,034	375	7,519	837	6,793	328	6,491	1,344	6,245	1,965	7,179	583	6,875
	$2,239,591		$2,654,960		$3,487,995		$3,634,255		$4,415,600		$5,870,300		$5,635,515		$1,629
	24¼—21		24—19⅞		27—17⅛		32¾—20¾		39—29		55—39		50½—28		42—2

[2] Mine in Keweenaw county.

[3] Mine in Houghton county.

[4] Mi

STATISTICAL TABLE.

Number of Net Tons of Refined Copper Produced by the Mines of Michigan. *By Charles D. L*

	*1867.		1868.		1869.		1870.		1871.		1872.		1873.		
	Tons.	Lbs.	Tons.	Lbs.	Tons.	Lbs.	Tons.	Lbs.	Tons.	Lbs.	Tons.	Lbs.	Tons.	Lbs.	Ton
	------	------	------	------	------	1,154	1	931	3	391	8	1,055	3	1,345	
	31	493	117	536	------	------	------	------	------	------	------	------	33	200	------
	------	------	------	------	1	1,775	------	------	------	------	------	------	a 10	1,163	a 5
	------	1,760	764	258	823	857	186	617	------	------	------	------	431	1,366	6
	40	------	36	------	87	1,267	12	1,288	6	1,153	5	1,550	------	------	
	675	1,173	2,549	375	6,157	1,771	7,030	1,584	8,111	590	8,081	1,836	9,424	265	10,0
	687	795	1,353	1,827	903	1,801	663	1,156	716	662	623	56	751	1,117	8
	560	1,725	613	1,746	362	1,247	222	381	71	238	59	386	375	1,203	5
	1,128	1,485	239	1,384	345	1,400	386	990	239	883	260	862	543	640	5
	------	------	------	------	------	------	------	------	------	------	81	1,161	140	743	
	------	------	------	------	73	1,662	55	1,420	22	1,048	------	------	------	------	------
	701	455	734	1,326	779	970	589	------	300	1,000	186	------	183	------	2
	------	------	79	1,282	36	314	------	------	------	------	------	------	------	------	------
	------	------	------	------	------	------	1	1,345	------	------	------	------	------	------	------
	683	1,169	740	80	841	863	a 42	183	a 134	1,453	a 276	1,689	a 273	1,883	a 1
	------	------	------	------	------	------	4	630	9	1,482	32	1,100	50	845	
	381	852	147	1,033	a 75	672	------	------	a 90	1,217	a 125	164	a 120	100	a
	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------
	------	------	------	------	53	977	------	------	------	------	8	1,559	35	442	
	5	40	9	939	1	1,213	1	1,408	9	692	------	1,903	4	265	
	188	570	115	900	113	1,500	200	1,500	184	------	126	------	74	171	
	330	922	309	1,820	128	947	130	660	205	1,086	168	770	83	1,870	
	84	480	99	1,360	9	45	------	------	4	1,839	------	------	------	------	------
	------	------	------	------	------	------	------	------	------	------	------	------	------	------	4
	163	660	------	------	------	------	------	------	------	------	------	------	------	------	------
	823	458	521	1,523	480	409	273	------	222	600	233	1,000	286	400	1
	155	115	130	------	398	630	499	1,000	609	1,862	364	470	260	1,080	6
	1,013	1,000	727	1,208	1,000	1,365	1,248	1,777	1,204	1,501	1,134	1,134	1,400	------	1,5
	94	1,537	86	------	126	1,840	122	1,400	175	150	128	1,920	115	1,140	1
	------	------	------	------	a 4	290	a 213	366	a 371	1,288	a 192	242	a 154	1,785	a
	309	946	166	1,118	93	368	------	------	------	------	------	------	------	------	------
	43	1,723	65	665	23	197	------	------	------	------	9	72	40	1,867	
	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------
	964	1,465	1,026	70	275	1,335	221	392	179	1,373	175	604	185	1,735	2
	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------
	8,763	1,607	10,467	124	13,312	1,300	12,311	849	12,373	349	12,266	1,523	15,045	1,505	17,1
	$4,442,841		$4,940,424		$6,230,016		$5,096,752		$5,728,485		$7,979,400		$8,726,100		$
	29¼—21½		24½—21¾		27—21¼		23¾—19		27¼—21¼		45—27¼		35—20		

Isle Royal county. [4] Mine in Houghton and Keweenaw counties * P

1874.		1875.		1876.		1877.		1878.		1879.		1880.		1881.	
s.	Lbs.	Tons.	Lbs.	Tons.	Lbs.	Tons.	Lbs.	Tons.	Lbs.	Tons.	Lbs.	Tons.	Lbs.	Tons.	Lbs.
2	165	15	470	20	784	32	609	27	115	10	1,785	1	951	3	1,500
				3	15	5	1,998		1,746						
04	134	a 692	1,574	a 780	1,875	a 650	279	565	1,146	715	1,452	659	471	736	1,007
86	406	783	1,036	917	1,041	1,027	304	1,132	1,592	1,153	1,822	1,170	1,195	1,264	9
6	1,412	8	252	13	1,378	14	1,934	11	1,392	8	737	2	1,757		
62	1,225	10,736	1,954	10,845	737	11,284	468	12,625	1,128	13,135	943	15,837	1,239	15,680	781
70	900	733	952	1,080	1,400	997	1,610	943	1,013	809	1,495	1,013	78	709	405
27	901	581	873	450	146	80	1,319	207	415	67	336	39	962	39	1,392
35	359	203	1,587	8	1,488	5	1,950	5	1,790			3	615	334	1,121
40	1,271	12	1,220	88	1,701	16	1,417	140	345	70	12	116	1,814	193	91
								35	1,873	15	405	5	651		968
83	1,790	583	800	963	641	1,169	1,817	1,299	1,528	1,414	1,703	1,168	466	1,338	1,932
								17	124	17	1,423	38	1,860	13	264
						1	1,555	3	807	1	50				
25	1,005	a 31	1,289	a 31	1,857	a 41	161	32	1,100	14	1,760	35	285	127	515
3	1,535	4	762	5	653	8	1,703		1,488		417				
90	876	a 48	682	a 14	199	a 15	1,985	15	1,933	13	880	38	1,469	23	1,308
3	215	3	562			2	1,975	4	629						
5	1,925	1	1,014	40	1,952	50	238	206	339	228	294	258	1,159	233	1,684
93	338	66	1,419	44	954	56	1,148	87	1,027	46	762	16	33	12	227
71	52	49	878	83	647	34	737	11	736	8	1,506				
								1	800	8	1,937	2	1,885	8	776
68		665	303	846	1,737	1,382	777	1,352	1,998	1,598	1,387	1,691	1,537	2,089	1,976
17	607	312	1,271	284	995	346	1,777	261	1,836	168	519	485	509	938	244
99	400	702	276	698	530	511	493	150	1,172	271	1,426	218	10	204	1,357
25	654	1,399	281	1,536	1,171	1,427	336	1,480	449	1,323	1,458	1,848	263	2,753	848
87	113	164	447	145	18	148	815	125	1,837	107	1,469	111	1,353	117	1,606
5	618														
									1,622			23	931	5	31
2	1,400											6	1,195	62	1,493
70	58	219	1,155	223	361	169	562	94	1,889	104	155	65	1,649	381	1,319
66	1,389	18,019	1,497	19,135	997	19,513	671	20,845	1,266	21,425	1,529	24,869	367	37,270	909
8,009,356		$8,180,626		$7,998,480		$7,327,888		$6,920,540		$7,327,350		$9,947,673		$9,971,702	
25—19		23½—21½		23—18¾		20⅜—17½		17½—15¾		21¾—15		24½—18		20¼—16¼	

revious to 1855. † Now Flint Steel. a May 1st of the foll

2.	1883.		1884.		1885.		1886.		1887.		1888.		Total.		Names of Copper Mining Companies.
Lbs.	Tons.	Lbs.	Tons.	Lbs.	Tons.	Lbs.	Tons.	Lbs.	Tons.	Lbs.	Tons.	Lbs.	Tons.	Lbs.	
429	-------	-------	2	333	4	436	-------	985	-------	-------	-------	-------	-------	-------	Adventure.
-------	424	1,400	612	1,981	-------	-------	65	1,556	-------	-------	-------	-------	-------	-------	Peninsula (Albany & Boston.)
1,557	875	1,377	964	174	1,085	476	862	1,463	442	1,010	157	198	10,546	931	Allouez.
1,708	1,341	197	1,581	1,585	1,791	533	1,751	1,670	1,820	1,865	1,987	972	21,730	1,671	Atlantic (South Pewabic).
1,129	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	Aztec.
1,528	16,562	1,045	20,237	585	23,623	1,990	25,259	220	23,008	123	25,147	1,721	292,204	1,281	Calumet & Hecla.
1,597	634	556	723	747	1,078	1,408	1,256	886	1,099	1,133	908	717	21,505	1,023	Central.
53	5	374	14	255	4	332	11	342	-------	145	-------	-------	-------	-------	Cliff.
1,500	402	-------	445	1,168	575	538	698	679	368	477	580	-------	10,452	610	Copper Falls.
249	111	117	599	691	20	1,155	22	505	4	913	-------	-------	-------	-------	Conglomerate (Delaware).
-------	-------	-------	-------	955	3	736	-------	1,006	-------	1,077	13	888	693	1,835	Evergreen Bluff.
120	1,744	708	1,882	1,697	1,999	1,172	2,032	297	1,957	1,838	1,827	1,751	29,568	67	Franklin.
1,080	367	1,598	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	Grand Portage.
-------	-------	-------	-------	-------	5	342	9	1,135	8	1,155	7	631	52	1,046	Hilton (Ohio).
579	360	213	963	1,660	1,335	1,163	996	695	742	103	1,187	1,147	9,542	506	Huron.
1,625	8	402	89	351	13	1,433	3	1,488	-------	-------	-------	-------	333	1,772	Belt (International, Bohemian).
1,447	-------	8	874	-------	15	164	-------	-------	-------	-------	-------	-------	4,602	71	Isle Royal.
-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	414	1,185	414	1,185	Kearsarge.
-------	-------	10	1,368	-------	10	1,976	19	806	19	870	-------	-------	323	1,993	Knowlton.
1,440	329	1,474	281	718	181	1,500	123	1,179	8	-------	35	944	-------	-------	Mass.
672	3	226	-------	1,144	6	608	-------	-------	-------	-------	-------	-------	17,352	668	Minesota.
1,060	13	6	43	1,368	81	252	92	706	12	1,187	-------	-------	-------	-------	National.
207	1	1,000	-------	1,106	6	291	-------	-------	-------	952	-------	-------	491	308	Ogima.
782	2,128	409	2,123	1,630	969	1,169	1,780	786	1,791	1,723	2,067	320	23,046	534	Osceola.
-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	Pennsylvania (Northwestern).
666	585	1,847	115	1,543	-------	-------	-------	-------	-------	-------	-------	-------	13,894	620	Pewabic.
1,177	256	291	310	1,004	180	1,108	50	1,804	6	1,497	-------	-------	7,773	39	Phœnix.
1,796	3,006	239	2,825	1,130	2,924	497	2,961	1,519	2,804	1,762	3,183	1,889	50,039	1,892	Quincy.
936	30	155	37	30	36	1,390	79	272	42	902	25	890	2,516	1,956	Ridge.
1,554	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	983	83	Centennial (Schoolcraft).
1,299	-------	-------	4	1,828	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	Sheldon & Columbian.
1,126	62	1,225	69	1,407	38	1,686	-------	-------	-------	-------	-------	-------	505	1,071	St. Clair.
-------	3	1,435	-------	-------	90	1,669	1,823	517	3,702	1,606	5,704	1,217	11,425	844	Tamarack.
1,651	594	110	694	1,262	310	1,466	126	1,316	35	122	2	1,860	13,936	1,687	Sundry Co.'s and tributers.
-------	-------	-------	-------	-------	-------	-------	301	922	215	330	-------	-------	215	330	Rolling Mill Scrap.
1,980	29,855	404	34,297	591	36,093	114	40,429	752	38,112	927	43,166	263	569,982	1,901	Total No. net tons and pounds.
522,416	$8,955,361		-------		-------		-------		-------		-------		-------		Total value (New York city).
⅝—17⅞	18—14¾		15—10⅜		11¾—10⅜		-------		-------		-------		-------		Highest and lowest price.

year.

b Consolidated with the Flint Steel River.

GOLD.

MICHIGAN GOLD MINES.

An unusual degree of attention has been given of late to the gold prospects in the vicinity of Ishpeming. A greater amount of exploration is in progress at the present time than ever before, and the success which is met with, at least in some instances, is sufficient to stimulate activity in this direction, and to sustain and even to increase local and general public interest in this work.

The winter has been favorable for exploration, being comparatively mild and open, and some very rich pockets have been discovered in the quartz veins that have been uncovered and worked in.

One can see small bottles full of bits of native gold that have been picked up recently after blasts were fired, and procured by crushing and washing fragments of quartz. Also pieces of the rock that are as well charged with gold as the Calumet and Hecla conglomerate is with copper; pieces of rock as large as one's fist that contain $20 in value of pure gold. These rich pockets are not large, but a number of them have been found at different places, and one quite recently that was the equal in richness of any heretofore discovered. Almost daily some explorer exhibits specimens of quartz showing native gold that he has found in his searching for the precious metal.

A person may go to some of the mines, or locations where good results have been attained, and may find particles of gold, perhaps, after a blast, or pieces of rock containing it, or, at any rate, he can crush a small portion of the vein matter in a mortar, and by suitably washing it he will be nearly certain to discover a trace of gold. I have tested the rock in this way both on the ground and have carried away pieces that I have subsequently manipulated, and nearly always with the result of finding at least a trace of gold in the pan.

It is certain that gold exists in our rocks, that we have gold bearing veins that yield a fair percentage of this metal as an average of the rock, and which also contain occasional small pockets that are exceedingly rich. It remains to be found if these veins are persistent in depth and in lateral

extent, and if the gold disseminated in them may not occur in larger percentage than as yet found; and also if the few rich pockets, thus far so aggravatingly small and far between, may not exist at greater depth or in other locality in larger magnitude and with greater frequency.

In all scientific investigations, especially in geology and in exploration for minerals, enough caution can scarcely be exercised against too great generalizations from too small basis of fact. This principle is illustrated constantly; every mining district has its instances, and very recently in our own State we have had an ample verification of its truth. And yet, if discoveries shall be made, if there shall be any progress in the world's knowledge or the world's material wealth; if the places of concealment of the earth's minerals shall be pointed out, and these stores of wealth be added to increase our prosperity; if the varied and innumerable industries, the multiple avenues for the employment of labor and for liberally rewarding it, so dependent upon mineral discovery and production, shall be met, the nation be developed and the people rendered prosperous and happy, it follows inevitably that some men *must* have enthusiasm—some men must have zeal and faith, and must hunt, and explore, and dig, and labor, and endure privations, and spend time and money, perchance, in hopeless work, haply with most beneficent results. These men are the pioneers—the men who carry their food and tools into the woods, and search, and delve, and endure; who have crudely learned, sometimes skillfully, to read the teachings of the rocks, and who possess the nerve to take the risks to attempt to verify their interpretations.

The world owes much to its pioneers and enthusiasts in every department of human endeavor. And to the men who earlier braved the hardships of this peninsula of northern Michigan, who penetrated its endless forests and interminable swamps, and risked health and their limited hard-earned capital on the uncertainties of discovery, our meed of praise cannot be too freely awarded. They led the way for capital by first demonstrating the safety of investment.

Of the explorers on Lake Superior nature exacts her full dues. On the other hand, to aid them in their efforts she has afforded ample indications, in the rocks, of the minerals which are sought, and has abundantly rewarded, on the average, the labor which has been expended to obtain them. The first explorers searched only for gold and silver, and little cared for the grosser metals, for the production of which the region has since become so widely celebrated. May it not be possible that the dream of the early *voyageurs* and explorers, who skirted the shores of the great lake in their canoes and penetrated the trackless forests to eagerly scan the rocky exposures for precious minerals, shall be ultimately realized, in so far, at least, as

to place the production of gold in Michigan in the list of its profitable mining industries? Certainly the indications point to such a result. There has been lately a greater amount of exploration for gold than at any former period, and a greater corresponding degree of encouragement has been given to the work. More effort has been made and greater success has waited upon the increased exertion.

The Upper Peninsula is a remarkable mineral region; it is full of anomalies, and while it is but natural that gold, being the most universally disseminated of all metals, should exist in some degree in the rocks of Lake Superior, still there is enough in the character of the rocks when exploration is made, and enough of the metal actually found in reward of the search that has been made to justify a reasonable expectation that at no distant day gold mining will be one of our established industries.

The portion of country which is now receiving the attention of explorers for gold, and in which all the recent rich "finds" have been made, lies northwest of Ishpeming, commencing with the Ropes, which is the most easterly of the gold developments, and which is three miles in a right line from the city. The others are west, within the extent of three miles from the Ropes. The region is desolate in the extreme—a surface of bare rocky knobs, with small cedar swamps between. Mainly these rocks are eruptive, interspersed with those of very ancient sedimentary origin. Originally sedimentary, they were subsequently greatly metamorphosed—altered and dislocated by the protrusion of the serpentine and diorite, which now constitute the most characteristic rock features of the locality. This serpentine, at the Ropes, and the associated diorite, which chiefly occupy the country for many miles, are of unquestioned eruptive origin. They are traversed by dikes which also contain veins of quartz that doubtless have their origin in the same deep seated sources as the rocks which enclose them.

The most important "finds" are in the south part of section 26 and north part of Sec. 33, T. 48, R. 28; being two miles west and one-half mile south from the Ropes. Veins occur in the diorite and in dikes in the diorite, that has protruded through the ancient sedimentary rocks.

The exploration that just now, March 10, is occupying the principal share of public attention is the Finn, to be held and operated by the Grayling Gold and Silver Co., Maurice Finn, general manager. The location is the S. E. $\frac{1}{4}$ S. E. $\frac{1}{4}$ Sec. 26, though he holds also the adjoining 40 west, and with Mr. J. M. Case, of Marquette, Mr. Finn has an option on and is exploring the S. $\frac{1}{2}$ of the S. $\frac{1}{2}$ of the S. W. $\frac{1}{4}$ of Sec. 26, where they are tracing and examining a quartz vein in granite. The Peninsula Gold Co.'s location is the S. W. $\frac{1}{4}$ of Sec. 25, owned by Peter Gingrass, of Ishpe-

ming, and held on a lease by the party exploring it. Mr. Gingrass receives a bonus for the lease, $20,000 he informs me, and ten per cent of the net proceeds of subsequent work. The parties holding it are from Detroit; they have sunk 50 feet vertically, and have a well-defined vein and get some free gold. A test of the rock, 70 tons, is to be made at the Ropes mill soon. Mr. Finn, coming into the country last fall (1888) and becoming interested by what he heard and saw in regard to the finding of gold, began to explore for himself. He traced the Peninsula vein west as well as he could, and sought to uncover it, and so far succeeded that he has found rock equal to any in richness that has yet been discovered. The land is owned, I think, by the Breitung Estate, of Marquette, and is now secured by a lease to Messrs. Finn & Mickilson. The point where the exploration is carried on is about midway of the 40, north and south, and 150 feet west of the east line. The opening is about 50 feet east and west; quartz vein three feet wide, dipping south 70°. The vein is in diorite, but the contact rock is of a schistose, argillaceous character, which contains fine gold, as I personally ascertained while on the ground. Mr. Finn has opened in two veins, about 50 feet apart; but has begun to sink a shaft in the north vein.

He contemplates erecting a 5-stamp mill to work up and test the rock obtained in the exploratory and opening work.

THE SUPERIOR

is directly south of the Finn. The company is working in the same vein as the Michigan and the Lake Superior, being in the 40 joining the Michigan on the east. The description is the N. E. $\frac{1}{4}$, N. E. $\frac{1}{4}$ Sec. 35, 48, 28.

Dr. Van Devener, President, Ishpeming, Mich.; C. R. Ely, Secretary and Treasurer, Ishpeming, Mich.

THE MICHIGAN GOLD COMPANY

holds the adjoining 40 west. A small lake takes up about one-quarter of the land and will afford water for the stamp mills for this and other contiguous mines. In my last report I fully described this property and all that had been done. Since then a shaft has been sunk to a depth of 53 feet, and cross cut south 21 feet made. They are now driving west. In the cross cut a portion of the rock passed through is porphory. The vein rock obtained in sinking this shaft, exclusive of all rock in which any free gold could be discovered, 73 tons in all, was stamped at the Ropes mill and was found to crush easily as compared with that of the Ropes mine. It yielded

$6.00 to the ton, I was informed. But aside from this, the richest quartz yet obtained was found in this shaft; specimens that yield an average of $100,000 to the ton. Not much of such rock was found, however. A six ounce piece was used to make the above cited assay.

The fee of the land is held by Peter Gingrass, who leased to a party that allowed the contract to expire and who paid no bonus and did no work. Afterwards Gingrass gave a lease to the men who formed the Michigan Gold Company, and who have done the work and discovered the value in the property. The former lessee brought suit on the ground that he had not been legally dispossessed, and this matter, as to which party is the rightful lessee, is awaiting decision in the State Supreme Court. If decided in favor of the Michigan Company, a stamp mill will be erected and the work of mining it pushed vigorously. At least such is the declared intention.

F. P. Mills, Agent, Ishpeming; Richard Trevarethen, Superintendent, Ishpeming.

THE LAKE SUPERIOR IRON CO.'S

gold mine is directly west of the Michigan, but a short distance. Here, also, very rich vein rock was found, as described in my last report. The company has a small hoisting plant and is working quite systematically. It has a well made shaft 100 feet deep; some drifting has been done, at bottom and at 40 feet from surface. The vein is well defined quartz, two feet wide. The company is making a stock pile of the best of the rock broken, working only a few men.

THE GITCHIGAMME

comprises the west half of the N. W. $\frac{1}{4}$ Sec. 36, south of Peninsula. East of this are the Grammet and the Giant, the former, the north 40—the latter the south 40. The two making the E $\frac{1}{2}$ of N. W. $\frac{1}{4}$, Sec. 36.

The Brown and the Case properties, so called, comprise the W. $\frac{1}{2}$ of N. E. $\frac{1}{4}$, Sec. 36—the Brown the west 40, the Case the east.

There are many other places where prospecting is going on, but so far the Lake Superior, Michigan and Finn are the only ones that have shown much gold.

IN SECTION 33,

but a short distance northwest of the city, has more recently been made what is considered a very favorable showing, samples of the rock assaying $43 and $179 to the ton, though it is not, I believe, thought that these

samples represent an average of the rock. The sample did not show free gold. The vein is, so far, two feet in width.

Mr. C. R. Ely and others at Ishpeming are the parties conducting the work, etc.

THE ROPES MINE,

in the N. ½, N. W. ¼, Sec. 29, 48, 27, is looking well. I went through it about the 1st of March and was pleased with it. Everything seemed to be moving systematically. The new mill and the new shaft house are important additions to the mine. They are running now 45 heads of stamps and treating 60 tons to 75 tons of rock per day, and work a force of about 60 men. There is room in the new mill for 20 more stamps. The new stamps weigh 850 pounds; the old ones, 750 pounds. Also the new vanners have amalgamating plates while the old ones have not. The engine for running the mill is 235 horse power. There is a separate engine for the hoisting and an engine in the rock house runs the Gates crusher. The rock is dumped from the skip into the hopper and passing through the crusher is discharged directly into the tram car and thence goes to either of the mills.

The shaft is 450 feet deep, down to the 9th level, at which point they have begun to "open out" both east and west. I descended to the bottom and found the size of the vein at that point in no wise diminished. It is 8 or 9 feet in width and uniform throughout. It appears to be mineralized, to some extent, throughout its section; that is, holds particles of sulphuret, a good indication.

Since I went through the mine Mr. Ropes, the President of the company, has made his annual report and I find that my notes so closely accord with his statements that I cannot do better than to give the further description in his words. However, I may add that the company has since decided to provide 20 additional stamps.

The work of sinking the main working shaft has been prosecuted five and one-half months during the year, and the shaft has been sunk 65 feet, and now at the depth of 441 feet is at the 9th level. Work was suspended May 1st, pending the decision of the syndicate which desired to take a large block of stock in the company. Work was resumed August 15th, but was again suspended during the construction of the shaft house, enlargement of the shaft and putting in of the skip-way.

The sinking of the shaft should be pushed night and day with all possible dispatch, with power drills, as is being done at the present time. A station has been cut in the foot wall at the 8th level in which a steam hoist has been placed that will raise all the ore mined down to the 10th level, thus guarding against interference with the other work.

The Ely shaft, 350 feet east of the Curry shaft, has been sunk 25 feet; sinking having been prosecuted 52 days, and the shaft is now 100 feet deep. It is entirely in the

mineral dike, which is 50 to 60 feet wide, as is shown by the crosscuts, 30 feet north and south respectively. Twelve to fifteen inches of typical gold bearing quartz was cut near both contracts, but was of low grade. Drifting each way will doubtless show pay ore bodies, and at further depth as well, judging from general indications. To curtail expenses work was suspended here on the first of July.

The number of feet of sinking done during the year was 90; drifting, 226; crosscutting, 165; winzes, 134. The developments of the year have added very much to the knowledge of the ore bodies and formation. Special attention, aided by numerous assays, has been given to determining the position of the pay chutes. There are ample reserves in sight to furnish milling rock for a long time to come.

Surface improvements during the year include the building and fitting up of a laboratory, 12x20 feet, the remodeling of the office, 12x16 feet, the building of a new shaft house, 30x32 feet and 45 feet high, the construction of a skip-way to the 8th level, and the purchase of a No. 5 Gates rock breaker and a 50-horse power engine to drive the same, and a small Gates crusher to break samples for assaying. The large crusher and engine were placed in the shaft house. This was rendered imperative by the destructive effects of the dust from the breakers on the wearing parts of the mill machinery when the crushing was done in the mill proper. The advantage in this and other respects more than compensate for any extra cost incurred in arranging for a separate equipment. To complete these several improvements enumerated above the mills were shut down on October 19th. The old shaft house taken down and the new one built and machinery placed in time for resumption of work on November 28th, since which time the mills have been in continuous operation, the whole moving along without jar or conflict, crushing 70 to 75 tons per day. In this connection it may not be out of place to refer to the criticism that obtained regarding the amount of rock crushed per stamp in 24 hours. In the test of 70 tons of the Michigan Gold Company's quartz made on January 19th, 11 to 12 tons readily passed the battery, while but 7 or 8 of our rock passed, all the conditions of the batteries being the same, this showing conclusively that the cause of the slow crushing of our rock is to be found in its obdurate nature. Much of our rock is talcose in character and obstructs the screens.

We note changes of management during the year as follows: The resignation of Capt. Mose Williams, September 1, after being in charge of the mine for a year; the appointment of W. H. Rood, general manager, in October, and the succession of Capt. Williams by Geo. Weatherstone, superintendent.

The new mill was got in shape to run continuously on the 16th of May. Counting out the stoppage of October and November, it has run eight and one-fourth months. Deducting the stoppage from April to June, to make repairs and connect with the new mill, and the stoppage in October and November, the old mill has been in operation nine and one-half months.

The number of tons of rock crushed during the fiscal year ended February 28th was 16,855, giving an average yield in mill of $3.42 per ton. Tailings have ranged in value from 60 cents to $1.40 in gold. and from 15 cents to 48 cents in silver, varying according to grade of ore.

Division of opinion has existed about the treatment of the higher grade of ores, some thinking that they should be shipped to smelting works. To settle definitely this question, 7½ tons high grade ore was selected and milled in one battery. The ore assayed, as near as it could be sampled, $10.50 in gold and $32.64 in silver—total, $43.14 per ton.

The tailings of this rock assayed $2.16 in gold, and $6.33 in silver per ton. To have shipped this ore to the smelting works would have cost at least $25 per ton, and the milling at home therefore showed a saving of 16 per ton. This ratio will apply to ores worth up to 100 a ton.

In the matter of treating the concentrates on the spot, the product is so complex that no method seems applicable except smelting, and to import the necessary lead ores would cost quite as much as the present expense of shipments to the smelting works. Parties have written of having a process for quickly and cheaply reducing the concentrates, but they have not reported their results, or what they can guarantee, as yet. Continued efforts will be made to solve the problem.

The number of men at present employed is 62, which is about the force required for the volume of work now going on. The force is divided as follows: In the mine 40; in the mill, 15; on surface and at other work, 7. A chemist is employed to do the assaying, time-keeping and other clerical duties.

For a statement of the receipts and disbursements for the year, you are referred to the Secretary's report, presented herewith.

J. ROPES, *President.*

ISHPEMING, MICH., *March 11, 1889.*

On hand, March 1 statement	$1,277 37	
Received on 50c. assessment called Sept. 4, 1888	40,000 00	
for interest	111 57	
for bullion 1½ months	45,183 78	
for concentrates	5,047 95	
for wood, rent, etc.	270 75	
from Ishpeming National Bank	9,000 00	
		$100,891 42

Contra.

Prid Ishpeming National Bank	$15,000 00	
insurance, taxes, etc.	2,689 21	
assaying	511 71	
mining and labor	23,045 07	
supplies	14,559 78	
general expenses	877 97	
freight	594 94	
superintendent	1,800 00	
wood and coal	9,610 45	
office expenses	928 20	
machinery	4,463 74	
explosives	3,486 15	
mill and labor	10,991 97	
interest	1,187 45	
machinery repairs	1,923 95	
improvement account	4,452 13	
On hand	4,793 69	
		$100,891 42

ASSETS.

Available Assets.

Cash	$4,793 69
Supplies at mine	2,910 39
Horses, sleighs, etc.	975 00
1,757 cords wood, $2.00	3,514 00
Accounts receivable	735 42

Laboratory	$150 00	
Office supplies	165 00	
Concentrates at works and mine	2,530 00	
		$15,773 50

Unavailable Assets.

Old mill machinery, buildings, etc	$49,495 63	
New mill machinery, including building cost	25,388 10	
Water works, cost	4,048 78	
New crusher, shaft house, etc	6,602 13	
		85,534 64
Total assets, exclusive of mine		$101,308 14

Liabilities.

Notes	$260 00
Accounts payable	2,485 04
Fuel account, wood and coal, not due	1,929 50
February pay roll	2,888 86
Total	$7,563 40

Product of Mine to March 1, 1889.

	Gold.	Silver.	Total.
Gross bullion	$41,148 11	$1,621 39	$42,769 50
Gross concentrates	11,205 83	3,709 42	14,915 25
Total	$52,353 94	$5,330 81	$57,684 75

No. tons quartz treated for the year	16,855
Average yield per ton for year	$3 42
Average yield per ton for last 5 months	4 18½

C. R. ELY, *Secretary.*

THE WASHBURN MINING AND MILLING CO.

has made considerable progress in the past year at its location southeast of Wakefield in the Gogebic range in Sec. 23, 47, 45. The work done has been more in the way of exploration than of development and entire satisfaction in the results is expressed by those interested. They claim an abundance of rock that will afford an average yield of $9 per ton. Estimates made by Dr. N. Lehnen are very favorable. A mill has been built containing crushing and other machinery and it is further proposed to erect an additional one to hold a hundred stamps; to also add compressors, air drills, hoisting machinery, etc.; to sink a shaft 400 feet deep and push the underground opening work accordingly. If all is done that is contemplated, and the results of the work accord with the estimates, the Washburn will become one of the most important mines in the State. They are working in a vein of quartz and schist, inclosed in a formation of chloritic and mica schist. The rock varies, being nearly a mica shist or a chloritic schist. The directors of the company, etc., are residents of St. Paul and Minneapolis. D. F. Strobel, Superintendent, Wakefield, Mich.

The Comstock, South Washburn and other companies have been formed and locations made in the vicinity of the Washburn. The assays of the rock as reported to me are sufficiently favorable and great hopes are entertained of final success.

GOLD IN THE MENOMINEE RANGE.

Hon. John L. Buell is exploring near the bank of the Menominee River south of Quinnisec in lot 4, Sec. 7; also in lot 1, Sec. 8, T. 39, R. 30, W., lands owned by the Menominee Mining Company. An assay of some of the rock recently made by Mr. Ropes gave a very large percentage of gold. I have been to the place, but not much work had been done when I saw it. More recently it is highly spoken of.

STONE.

for building purposes that is found in the Upper Peninsula is unsurpassed in beauty and in durability. The beautiful brownstone of Marquette, such as the Episcopal church in that city is built of, cannot be equaled in richness and uniformity of color by any other product in the country. Unfortunately there is too little of this variety; now that the supply is so nearly exhausted people have learned to appreciate it. They get at the Marquette quarry a variety that they designate "rain-drop stone." It is mottled sandstone having the appearance of having been spattered with rain-drops when in condition to receive the impressions.

Sandstone suitable for building is not confined to any locality; there are many places where it occurs and is of the best quality. It is found at Marquette and in its vicinity, at Grand Island, L'Anse, Portage Entry, Isle Royal and other places. The quarry at Marquette is owned and operated by

FURST & JACOBS.

who quarried at Marquette 20,000 cubic feet of building stone in 1888. They also operate a more extensive quarry at Portage Entry at the end of the peninsula, which separates Portage river and Keweenaw bay. Here they have 1,200 feet of dock and all the facilities for handling blocks of stone of any size. The company sent out from this quarry last year 340,000 cubic feet of stone. It is red sandstone, uniform in color, and of excellent texture. The rock is horizontally bedded and covered with 16 to 24 feet of soil and worthless rock. The description of the land is lot 1, Sec. 19, T. 53, R. 32. Postoffice, Jacobville, Mich. They convey stone from here to their dock at Marquette where they have machinery for working up and dressing the stone as may be required. The cutting machinery is of new design and the cutting up is now done in this shop with great comparative rapidity. The stone is worth about 50 cents per cubic foot at the quarry "in the raw."

PORTAGE RED SANDSTONE COMPANY

holds the S. E. $\frac{1}{4}$ Sec. 18, 53, 32, joining the Furst & Jacobs quarry at Portage Entry. The rock is the same in both, and each has about equal facilities for quarrying and handling the stone. This company produced in 1888

250,000 cubic feet of stone. The new Mining School building at Houghton is built of this stone. The following is an analysis of the Portage Entry stone:

Silica	94.73	per cent
Piroxide of iron	2.64	"
Alumina	0.36	"
Carbonate of lime	0.69	"
Carbonate of magnesia	0.75	"
Water	0.74	"
Loss, etc	0.09	"
Total	100	per cent.

LAKE SUPERIOR AND DETROIT BROWNSTONE QUARRY,

also known as David's Quarry, is on the south slope of Mt. Mesnard near the prison in Marquette. They are at work near the top. Thus far the work is mainly exploratory. It is also near the mouth of the Carp river.

BROWNSTONE ON THE BURT FORTY,

which is held on an option by parties in New York who are represented in Marquette by R. B. Moss. Mr. Moss has a few men at work under Anthony Pings and they have so far succeeded well, having discovered a deposit of brown sandstone 25 feet in width and so far have proved it a distance of 75 feet. Test pits elsewhere find the same layer of rock, they say, so that it seems likely to prove a workable deposit of brownstone. They are getting ready to increase the force of men and develop the property.

THE GILLETTE QUARRY

is another exploration for workable sandstone that is in progress on the lake shore, six miles from Marquette. J. H. Gillette, Marquette, Mich.

SANDSTONES IN LOWER MICHIGAN.

There are deposits of sandstone in the coal measures of southern Michigan, which are of very fair quality for building purposes. The best quarries of this rock are in Jackson and in Eaton counties—in the former at Parma and in the latter in Ionia township a few miles from Grand Ledge. Several edifices are built of this stone in Lansing, Mich.

The sandstone in the Upper Peninsula belongs to the Pottsdam period and is pretty well distributed over the country south of Lake Superior. It is generally horizontally bedded and, as before stated, in many places affords workable deposits of building stone.

BARAGA GRAPHITE MINING COMPANY

is a Detroit organization formed to work a graphite vein that outcrops in the bank of Plumbago creek; Sec. 33, T. 50 N., R. 33 W. I have not been on this ground since 1873, when I spent several weeks in the vicinity making a geological examination of the region and exploring for iron ore on Sec. 9, 49, 33. The occurrence of plumbago in this locality is well known, but it has not heretofore been found in quantity sufficiently pure to be of any commercial value. It is claimed that the Detroit company have a vein of the best quality. I have been so informed by persons who have seen it. There is a water power in the creek that will suffice for the purposes of grinding. The location, I think, is seven miles southwest of L'Anse.

GYPSUM.

GYPSUM.

For description of the plaster quarries and deposits of Michigan, and other particulars relating to this important industry, reference is made to former reports, particularly to the Commissioner's report for the year 1881, wherein I have described the deposits, quarries and mills, etc., quite fully.

TABLE showing the amount of Land and Calcine Plaster produced in Michigan, in each year since 1866, and the aggregate in previous years by C. D. Lawton.

Years.	Land plaster, Tons.	Stucco—Barrels. 300 lbs. each.
Years previous to 1866	100,000	30,000
1866	14,604	----------
1867	17,439	----------
1868	28,837	34,996
1869	29,996	41,187
1870	31,437	46,179
1871	41,126	8,685
1872	43,536	59,768
1873	44,972	82,457
1874	39,126	82,449
1875	27,019	61,120
1876	39,131	64,386
1877	40,000	55,000
1878	40,000	48,346
1879	43,658	50,800
1880	49,570	106,004
1881	33,178	112,813
1882	37,821	135,655
1883	33,225	201,133
1884	27,888	156,677
1885	28,181	141,575
1886	29,398	153,274
1887	28,794	170,145
1888	22,177	196,689
Totals	871,113	2,053,303

TABLE Showing the amount of Land Plaster and Stucco produced by the different Companies in Michigan, in the years indicated.

Name of Company.	No. of Tons of Land Plaster produced by Michigan Companies.										No. of Barrels of Stucco produced by Michigan Companies.*									
	1879.	1880.	1881.	1882.	1883.	1884.	1885.	1886.	1887.	1888.	1879.	1880.	1881.	1882.	1883.	1884.	1885.	1886.	1887.	1888.
Godfrey & Bro.	9,117	9,000	6,422	6,080	5,682	4,593	4,467	4,560	3,937	3,157	.....	23,000	27,500	30,274	37,000	30,433	30,942	28,273	30,284	36,656
Grand Rapids Plaster Co.	8,970	12,000	6,375	7,512	5,013	3,044	4,143	3,832	4,517	2,745	.....	23,500	20,400	32,854	40,000	24,390	26,498	28,627	32,386	34,751
Wyoming Mills	7,000	10,000	6,093	6,801	4,400	3,052	4,059	3,714	3,585	2,950	.....	.....	.....	.....	12,000	13,108	11,193	11,327	15,175	13,997
Union Mills	4,500	7,500	6,716	8,298	5,500	3,185	3,663	3,687	3,102	2,650	.....	37,000	34,913	23,074	30,000	23,176	15,654	18,027	21,979	30,971
D. Noble & Co.	10,585	9,570	6,572	6,037	4,000	3,202	3,900	1,947	3,106	2,640	.....	21,504	30,000	27, 93	38,000	30,288	26,344	28,760	34,235	33,121
Smith, Bullard & Co.	1,586	1,500	1,000	2,993	4,600	4,122	4,346	6,039	5,589	3,750	.....	.....	.....	11,817	30,961	23,961	20,797	27,113	21,152	25,036
Alabastine Co.	.....	.....	.....	.....	4,032	6,690	3,606	5,608	4,958	4,278	.....	.....	.....	.....	13,172	11,321	10,147	11,147	14,934	17,157
Geo. H. White & Co.	1,900	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Totals	43,658	49,570	33,178	37,821	33,225	27,888	28,181	29,398	28,794	22,177	.....	106,104	112,813	135,655	201,133	156,677	141,575	153,274	170,145	196,689

* Stucco is now reckoned at 7 barrels to the ton.

COAL.

STATISTICS OF COAL PRODUCTION.

I have heretofore described the coal formation of this State and this, with the details of the mines, will be found in former reports. Coal mining in this State has fallen off. There is less produced than there used to be many years ago. The business is less profitable now, they tell me, for the reason that coal is cheaper. Ohio and Pennsylvania coal is sold in the markets where our coal mines exist at a less price than Michigan coal can be mined for. Besides, outside coal is of better quality for most purposes. Again I am told by those who have engaged in the coal mining business in Michigan for a long time, that they do not succeed in finding coal at Jackson now in as large quantity and in as favorable situation for mining cheaply as they did formerly. R. H. Emerson & Co. continue to be the largest producers. Mr. Jesse Hurd, a veteran in this work, has been doing a good deal of exploring with a drill and as a result of discoveries which he has made is sinking a shaft on the Poole farm, two miles northeast of the city.

There are a number of small mines at Grand Ledge in Eaton county, which produce annually a few hundred tons each for local consumption.

These parties or mines are H. J. Starke, the Star Coal Co., D. D. Shane, proprietor; the Grand Ledge Coal Co., W. F. Ward, proprietor; Eureka Coal Co., Thomas & Quinn, proprietors.

The following table gives the coal production of the State. Those marked with a star did not report and the product given is estimated for the year.

Name of Company.	Years previous to 1877.	1877.	1878.	1879.	1880.	1881.	1882.	1883.	1884.	1885.	1886.	1887.	1888.
Williamston							10,454	884			1,000	100	
Jackson mine		67,147	61,785	65,000									
Corunna Coal Co.			22,537	16,215	12,252	7,060	8,624	9,000	8,000	10,000	15,975	8,000	14,735
Other mines		1,500	1,000	800							1,000		
R. H. Emerson & Co.					66,780	61,666	60,103	40,412	13,712	15,553	21,368	13,230	30,183
Eureka Coal Co.					30,000	37,477	25,000						300
Michigan Coal Co.					20,021	23,987	25,000						
Porter Coal Co.							6,153	21,000	15,000	13,000			
*Star Coal Mining Co.										5,123	5,821	7,333⅓	7,000
*Standard Coal Co.										15,000	4,734	5,000	1,000
*Spring Arbor Coal Co.												500	600
Bennett Sewer-pipe Co.												2,317	4,663
H. J. Stark, Grand Ledge												64	250
Star Coal Co., Grand Ledge													300
Grand Ledge Coal Co.													200
Total	350,000												159,231

SALT.

SALT.

The salt producing area of Michigan is the largest known in the world. The manufacture of this valuable product began in this State in 1860, in the Saginaw valley, to which section the mineral was supposed to be confined; but the discovery of salt in the valley of the St. Clair river, at Manistee and at Ludington, has extended the area in which it is produced.

The production of salt is auxiliary with the manufacture of lumber in this State.

THE SALT DISTRICTS.

The salt producing territory of the State is divided into nine districts, having a manufacturing capacity as follows:

District No. 1, Saginaw County—

Has 52 salt companies, with 45 steam, twelve pan blocks, and 4,000 solar salt covers, having a manufacturing capacity of 1,400,000 barrels of salt.

District No. 2, Bay County—

Has 29 salt companies, with 32 steam blocks and 500 solar salt covers, with a manufacturing capacity of 1,300,000 barrels of salt.

District No. 3, Huron County—

Has nine salt companies, with four steam, five pan blocks and with a manufacturing capacity of 250,000 barrels of salt.

District No. 4, St. Clair County—

Has 12 salt companies, with 10 steam and two pan blocks, and with a manufacturing capacity of 600,000 barrels of salt.

District No. 5, Iosco County—

Has nine salt companies, with nine steam blocks, having a manufacturing capacity of 300,000 barrels of salt.

District No. 6, Midland County—

Has three salt companies, with two steam and one pan block, having a manufacturing capacity of 100,000 barrels of salt.

District No. 7, Manistee County—

Has nine salt companies, with 10 steam and one vacuum pan block, having a manufacturing capacity of 900,000 barrels of salt.

District No. 8, Mason County—

Has three salt companies, with two steam blocks, one vacuum pan, having a manufacturing capacity of 300,000 barrels of salt.

District No. 8, Gratiot County—

Has one salt company, with one steam block, having a manufacturing capacity of 15,000 barrels of salt—did not run season 1888.

RECAPITULATION.

From the above we find there were 137 firms engaged in the manufacture of salt during the inspection year of 1888, operating 114 steam and 17 pan blocks. Total number of blocks, 130, and 4,500 solar salt covers, with an estimated manufacturing capacity of 5,165,000 barrels of salt.

The following table shows the amount of various grades of salt inspected in Michigan since 1869, the first year of the establishment of the State inspection law.

Comparative Table.

Year.	Fine.	Packers.	Solar.	Second quality.	Common coarse.	Total.
1869	513,908	123,908	15,264	19,177	.....	516,288
1870	568,326	17,869	15,507	19,650	.....	621,352
1871	655,923	14,677	37,645	19,930	.....	728,175
1872	672,034	11,110	31,461	19,876	.....	724,481
1873	746,702	23,671	32,267	20,706	.....	823,346
1874	960,757	20,090	29,391	16,741	.....	1,026,979
1875	1,027,866	10,233	24,336	19,410	.....	1,081,856
1876	1,402,410	14,233	24,233	21,668	.....	1,462,729
1877	1,590,841	20,839	22,818	26,818	.....	1,660,997
1878	1,770,361	19,267	33,541	32,615	.....	1,855,884
1879	1,997,350	15,641	18,020	29,027	.....	2,058,040
1880	2,589,037	16,691	22,237	48,623	.....	2,676,588
1881	2,673,910	13,885	9,683	52,821	.....	2,750,299
1882	2,928,542	17,208	31,335	60,222	.....	3,037,317
1883	2,828,987	15,424	16,735	33,525	.....	2,894,672
1884	3,087,034	19,308	16,957	38,508	.....	3,161,806
1885	3,230,626	15,480	19,849	31,428	.....	3,297,403
1886	3,548,731	22,221	31,177	71,235	3,893	3,677,257
1887	3,198,070	19,385	13,903	73,905	173,378	3,944,309
1888	3,720,319	18,126	26,174	87,694	13,915	3,866,228
Total						41,907,006
Salt manufactured prior to 1869						3,282,117
Total amount of salt produced in Michigan to date						45,189,123

The following figures show the average net price received by manufacturers for salt:

Average price per barrel,			1866	$1 80	Average price per barrel,	1878	$ 85
"	"	"	1867	1 77	" " "	1879	1 02
"	"	"	1868	1 85	" " "	1880	75
"	"	"	1869	1 58	" " "	1881	83⅜
"	"	"	1870	1 32	" " "	1882	70
"	"	"	1871	1 46	" " "	1883	81
"	"	"	1872	1 46	" " "	1884	75⅝
"	"	"	1873	1 37	" " "	1885	70
"	"	"	1874	1 19	" " "	1886	66
"	"	"	1875	1 10	" " "	1887	57 4-10
"	"	"	1876	1 05	" " "	1888	58 5-10
"	"	"	1877	85			

The charge has been broadly made that the Michigan salt product is unfit for curing meats and for dairy purposes, notwithstanding the fact that more than three-fourths of the beef, pork and butter packed in the United States every year is cured with domestic salt. As to the quality of this domestic salt, it is guaranteed to be equal to any salt in the world, either for salting pork, beef or butter, and the Salt Association have $10,000 to meet this guarantee, and stand ready to deposit that sum with a like sum to be put up by any other organization or individual in the world to enter into a series of tests with competent judges to be agreed upon to determine the superiority or otherwise of the high grade of Michigan salt over all other salts, either as to flavor or "staying qualities."

For further details of the salt production, reference is made to the report of George W. Hill, late Salt Inspector, from which the foregoing statistics have been extracted.

SLATE.

SLATE.

The slate production in Michigan is confined to the Michigan Slate Co. at Arvon, near Huron bay, Baraga county. The operations of the company have for the past year or two been chiefly confined to exploration and to producing a small amount of slate for market; about enough, they inform me, to pay expenses. In former reports full descriptions of the slate interests will be found, especially in reports for 1877–81–85, etc. I find nothing to add to what has heretofore been said. C. M. Turner, Superintendent, Arvon or L'Anse, Mich.

PIG IRON.

PIG IRON.

Statistics of Production of Pig Iron in Michigan Blast Furnaces, 1888 and several previous years:

Name of Company.	1884.	1885.	1886.	1887.	1888.
Eureka Iron and Steel Works, Wyandotte	6,000	10,904	11,668½	12,484	10,765
Gaylord Iron Company, Detroit	7,200	4,803	8,093	6,760	8,858
Detroit Iron Furnace Company, Detroit	6,205	13,619⅗	6,741	15,272	17,466
Union Iron Company, Detroit	8,000	3,303	6,000	8,753	8,782
Peninsular Iron Company, Detroit	7,200	7,439	5,263	9,207	9,303
Bangor Furnace Company, Bangor		6,891⅗	12,941	8,361	7,686
Elk Rapids Iron Company, Elk Rapids		16,077⅗	17,434⅘	14,888	15,726
Spring Lake Iron Company, Fruitport		17,217	17,768	18,381	14,811
Jackson Iron Company, Fayette		8,456	10,581	13,325⅗	14,706
Vulcan Iron Company, Newberry		11,426	17,360	11,854	16,580
Deer Lake Iron Company, Ishpeming		9,245⅗	10,898⅗	10,165⅗	8,717
Iron Cliff Company, Negaunee, Pioneer		15,718	11,079	18,787	23,235
Antrim Iron Company, Mancelona			9,414	16,240	18,158
Pine Lake Iron Company, Ironton			5,070	10,342	12,320
Martel Furnace Company			7,666	10,830	9,552
Gogebic Furnace Company				3,700	
Total		125,190	148,952		

The Gaylord Iron Co.'s furnace was in blast 355 days. W. M. Gaylord, Treasurer; N. Woods, Clerk, Detroit.

Union Iron Co.'s furnace was in blast 291 days, making an average output per day of 30 tons using an average of 88 6-10 bushels of charcoal to the ton. The total number ef tons of ore smelted was 14,572 which gave an average yield of iron of 60 %. William Gerhauser, Secretary, Detroit.

The Pine Lake furnace was in blast during 1888 192 days, making in that time the product of 12,320 tons. Location of furnace Ironton, Mich., and office Chicago, Ill. H. C. Dolph, Treasurer, Adams and La Salle streets.

The Elk Rapids furnace, situated at the place of the same name, was in blast during 1888 288 days. E. S. Noble, Secretary.

The Deer Lake furnace was in blast 330 days. W. H. Root, President, Ishpeming, Mich.

Martel furnace, St. Ignace, Mich., W. B. Vance, Secretary, was in blast 212 days in 1888.

Antrim furnace, situated at Antrim, Mich., E. Fitzgerald, General Manager, was in blast 360 days.

Peninsular Iron Co.'s record for 1887 is: Number of days run, 365; gross tons of iron made, 9,207; number of tons of ore used, 16,038; pounds of charcoal consumed, 16,373,030; pounds of charcoal used to ton of iron made, 1,780; average per cent of iron in ore, 57 4-10%. Record of the same furnace for 1888 is: Number days in blast, 366; gross tons pig iron made, 9,303; gross tons of ore smelted, 15,556½; number of pounds of charcoal used, 16,211,030; number of pounds of charcoal to ton of iron, 1,742; per cent of iron obtained from ore used, 59 8-10. Solon Burt, Secretary, Detroit, Mich.

Bangor furnace was in blast 180 days and made an average of 42¾ tons of iron per day.

Fruitport furnace was in blast 269 days, making 55 tons, average, per day. J. C. Ford, Superintendent.

Eureka Iron & Steel Co.'s furnace was in blast about seven months during 1888. J. S. Van Alstyne, Agent.

TABLE of Mine Products, 1888, and specific tax thereon as reported to the Auditor General, State of Michigan, by the Commissioner of Mineral Statistics:

Name of Company.	Tons of Ore.	Specific Tax.
American Iron Co.	13,669	$ 136 69
Aurora Iron Mining Co.	179,650	1,796 50
Ashland Iron Mining Co.	164,134	1,641 34
Anvil Mining Co.	24,677	246 77
Beaufort Iron Co.	8,282	82 82
Braastead Mines	88,636	886 36
Bessemer Consolidated Iron Co.	69,145	691 45
Buffalo Mining Co.	30,801	308 01
Brotherton Mining Co.	40,639	406 39
Champion Iron Co.	174,681	1,746 81
Cleveland Iron Mining Co.	182,733	1,827 33
Colby Mine	285,195	2,851 95
Chapin Mining Co.	290,872	2,908 72
Cambria Mining Co.	59,009	590 09
Dexter Consolidated Mining Co.	1,821	18 21
Detroit Iron Mining Co.	19,665	196 65
East New York Iron Co.	13,650	136 50
Federal Land and Iron Co.	3,182	31 82
Grand Rapids Iron Co.	11,612	116 12
Hamilton Ore Mining Co.	8,801	88 01
Humboldt Mining Co.	11,656	116 56
Iron Star Mining Co.	21,861	218 61
Ironton Iron Mining Co.	1,755	17 55
Iron Cliff Co.	185,329	1,853 29
Iron River Co.	109,952	1,099 52
Jackson Iron Co.	101,720	1,017 20
Lake Superior Iron Co.	240,225	2,402 25
Lumbermen's Mining Co.	61,883	618 83
Lucy Mining Co.	22,276	222 76
Lillie Mining Co.	32,692	326 92
Marquette Ore Co.	7,060	70 60
Michigamme Co.	36,448	364 48
Metropolitan Iron and Land Co. (Norris)	410,763	4,107 63
Metropolitan Iron and Land Co. (Iron County)	3,490	34 90
Milwaukee Iron Mining Co.	48,908	489 08
Monitor Iron Mining Co.	2,690	26 90
Millie Mining Co.	10,722	107 22
Negaunee Mining Co.	45,304	453 04

Name of Company.	Tons of Ore.	Specific Tax.
North Champion Iron Co.	5,685	$56 85
New York Iron Mine	11,480	114 80
Norwood Mine	3,553	35 53
North Republic	289	2 89
Nanarino Mining Co.	5,744	57 44
Paint River Iron Co.	12,506	125 06
Perkins Mine	16,684	166 84
Penn Iron Mining Co.	238,054	2,380 54
Pittsburgh and Lake Angeline Iron Co.	223,757	2,237 57
Palms Iron Mining Co.	23,184	231 84
Pabst Mining Co.	49,977	499 77
Pittsburgh and Lake Superior Mining Co.	56,321	563 21
Queen Mining Co.	5,527	55 27
Rolling Mining Co.	402	4 02
Republic Iron Co.	235,064	2,350 64
Republic Reduction Co.	20,846	208 46
Riverside Iron Co.	5,761	57 61
Ruby Iron Mining Co.	3,056	30 56
Sheldon & Shafer Mine	10,936	109 36
Sampson Iron Mining Co.	4,512	45 12
South Buffalo Mining Co.	24,707	247 07
South Mastodon Iron Co.	2,722	27 22
Sunday Lake Mining Co.	24,742	247 42
Titan Iron Co.	2,845	28 45
Youngstown Iron Mining Co	12,700	127 00
York Iron Co.	118,090	1,180 90
Wheat Mining Co.	4,982	49 82
West Republic Mining Co.	9,861	98 61
Wetmore Mine	2,115	21 15
Walpole Mine	870	8 70

Products of Copper Mines and Specific Tax thereon, reported to the Auditor General of Michigan—1888—by Commissioner of Mineral Statistics.

Name of Company.	Product.		Specific tax.
	Tons.	Pounds.	
Atlantic Mining Co.	1,987	972	$1,490 61
Allouez Mining Co.	157	198	117 82
Calumet & Hecla Mining Co.	25,147	1,721	18,860 90
Central Mining Co.	908	717	681 27
Copper Falls Mining Co.	580		435 00
Franklin Mining Co.	1,827	1,751	1,370 92
Evergreen Bluff Mining Co.	13	888	10 08
Hilton Mining Co.	7	631	5 49
Huron Copper Co.	1,187	1,147	890 68
Kearsarge Mining Co.	414	1,185	310 94
Osceola Consolidated Mining Co	2,067	320	1,550 37
Quincy Mining Co.	3,183	1,889	2,387 95
Ridge Copper Co.	25	890	19 09
Tamarack Mining Co.	5,704	1,217	4,276 46
Mass Mining Co.	35	944	26 60

Product of Coal Mines and Specific Tax thereon as reported by Commissioner of Mineral Statistics to the Auditor General of the State of Michigan, 1888.

	Tons of coal.	Specific tax.
R. H. Emerson & Co.	30,103	$150 40
Eureka Coal Co.	300	1 50
Corunna Coal Co.	14,735	73 67
Bennett Sewer Pipe Co.	4,663	23 31
H. J. Stork	250	1 25
Star Coal Co.	300	1 50
Star Coal Mining Co.	7,000	35 00
Grand Ledge Coal Co.	200	1 00
Spring Arbor Coal Co.	600	3 00

Statitsics of fatal accidents that have occurred in the mines in the Upper Peninsula during the year 1888, as reported to the boards of supervisors of the several counties by the mine inspectors thereof.

Houghton County, Josiah Hall, Mine Inspector.

Date.	Name of Man.	Name of Mine.	Cause of Death.
January 10	Richard Runkhald	Tamarack	Fall of rock.
January 19	Erick Niska	Osceola	Jammed by skip.
February 6	Kusto Launela	Franklin	Fell in shaft.
March 2	John Mahoney	Quincy	Fall of hanging wall.
March 2	Christian Yaas	Quincy	Fall of hanging wall.
April 20	John Murphey	South Hecla	Fall of rock.
May 5	Jacob Ginter	Osceola	Fall of hanging wall.
June 6	Thomas Jaukaneak	South Hecla	Fall of rock.
August 10	Mathias Porter	Tamarack	Fell in shaft.
August 24	Joseph Simmins	Tamarack	Fall of rock.
September 5	Thomas Anderson	South Hecla	Fall of rock down shaft.
October 19	Thomas Eagger	Franklin	Fall of rock.
November 6	Mike Keyjan	Calumet	Fall of hanging wall.

November 29, Antony Gattarara, Joseph Massoglia, Matt Rom, Joe Flek, Andrew Hansen, Gustav Tawa, Antony Kowalinsky, John Vanderbilt—all lost through the fire in Calumet & Hecla mine; bodies not yet recovered.

Keweenaw County, Joseph Rickard, Mine Inspector.

Date.	Name of Man.	Name of Mine.	Cause of Death.
October 10, 1888	William Connelly	Copper Falls Mine	Riding in shaft.
November 28, 1888	William Martin	Central Mine	Fall of rock.

Iron County, Elisha Morgan, Mine Inspector.

Date.	Name of Man.	Name of Mine.	Cause of Death.
June 7	Peter Mosier	Iron River	Fall of ore after blast.
June 18	John O. Westerburg	Iron River Mines	Fall of rock in open pit.
November 7	Joseph Negoa	York Mine	Fall of ore after blast.
December 15	Wm. Hockenger	Iron River Mines	Fall of ore in open pit.

From report of J. Parke Channing, M. E., Mine Inspector of Gogebic county, Mich., from Nov. 1 to Aug. 31, 1888:

Classification of Fatal Accidents.

Nationality.		Nature of Accident.	
English	7	Fall of ore	8
Swedes	6	Fell down shaft	4
Finlanders	4	Fall of rock	4
Italian	1	Explosion of powder	2
Irish	1	Fell down winze	1
Austrian	1	Fall of shaft house	1
Scotch	1	Fall of bucket in shaft	1
Total	21	Total	21

Occupation.		Mine.	
Miners	13	Colby	6
Trammers	4	Anvil	2
Timbermen	2	Aurora	2
Captain	1	Sunday Lake	2
Lander	1	Palms	1
Total	21	Ashland	1
		Iron King	1
		East Norrie	1
		Pabst	1
Surface men	2	Norrie	1
Underground	19	Explorations	3
		Total	21

Synopsis of Report of J. Parke Channing, Inspector of Mines for Gogebic County, for the ten months beginning November 1, 1887, and ending August 30, 1888.

	Actual ten months.	Estimated one year.
Number of iron mines in county	15	15
Number of iron explorations in county, approximate	30	30
Number of gold and silver explorations in county	4	4
Number of iron mines and explorations from which accurate statistics were furnished	19	19
Persons employed underground	2,171	2,171
Persons employed on surface	889	889
Total number persons employed	3,060	3,060
Number of fatal accidents underground	19	22.8
Number of fatal accidents on surface	2	2.4
Total number fatal accidents	21	25.2
Number non-fatal accidents reported	33	39.6
Number employed per fatal accident	----------	121.4
Number fatal accidents per thousand men	----------	8.23
Number gross tons iron ore mined	930,401	1,116,481
Number gross tons iron ore mined per fatal accident	44,305	44,305

Menominee County, J. B. Knight, Mine Inspector.—Record of Deaths by Accident.

Mine.	Date.	Name.	Cause of Death.	V'd't of Cor. Jury.
East Vulcan	May 22, 1888	Theophalis L'lord	Boss carpenter, timber slipped from lashing.	Accidental death.
West Vulcan	April 24, 1888	Frank Vitoni	Fell into winze or rock mill.	Accidental death.
West Vulcan	May 28, 1888	Guiseppa Padra.	Fell into rock chute and died from suffocation before they could be extricated.	Accidental death.
West Vulcan	May 28, 1888	Goiseppa Bello		
Perkins	Dec. 6, 1887	John Contratto	Jamming giant powder into hole with iron bar.	Accidental death.
Chapin	April 17, 1888	Nils. Larson	Injured by fall of rock from back of drift. Died May 6.	No inquest.
Chapin	Aug. 27, 1888	Per. Persson	Crushed by giving away of timbers in back of crosscut.	Accidental death.
Ludington	Oct. 24, 1887	Chas. Anderson	Killed by fall of ore while putting in timber.	Accidental death.

Record of Accidents.

Name of Mine.	No. men employed.	No. fatal Accidents.	No. Non-fatal Accidents.	No. persons killed by fatal Accidents.	No. persons injured by non-fatal Accidents.	No. men employed to each man killed.	No. men employed to each man injured.
East Vulcan	217	1	1	1	5	217	43
Central Vulcan	27		5		1		27
West Vulcan	427	2	12	3	14	143	31
Curry	23						
Perkins	48	1		1		48	
Norway	255		2		2		128
Cyclops	50						
Quinnesec	30						
Pewabic	33						
Walpole	34						
Millie	28						
Chapin	950	2	11	2	11	475	86
Old Ludington	14						
New Ludington	187	1	1	1	1	187	187
Hamilton	43						
Smaller mines	55						
Totals	2,421	7	32	8	34	303	71

Marquette County, Anthony Broad, Inspector.—Total number fatal Accidents occurring in Mines in Marquette Co. during Year ending October, 1888.

Caused by explosions, 11; by riding in skip, 4; by falling into shaft, 7; by fall of ground, 9; by rail cars in yard, 1; by unknown cause, underground, 2; by fall of derrick, 1—total 34.

They are distributed as follows: At Cleveland mine, 6; Jackson, 4; Champion 3; Republic 2; P. & L. Angeline, 2; P. & L. Superior, 2; Salisbury, 2; Cleveland Hematite, 2; Braasted, 1; Barnum, 1; Cambria, 1; Lucy, 1; Buffalo, 1; Gillett's stone quarry, 1. The total average No. of men employed was 6,381. In iron mines, 6,120; in gold mines, 120; in stone quarries, 123.

Total average labor force employed in different mines was as follows: Michigamme, 200; Champion, 629; North Champion 74; Humboldt, 72; Sampson, 58; Republic, 695; Northwest Republic, 24; Riverside, 59;

American, 45; Dexter, 23; Braasted, 260; Saginaw, 13; Kenworth, 9; Fisher, 36; Salisbury, 109; P. & L. A., 450; Lake Superior, 720; Barnum, 195; Cleveland, 509; C. Hematite, 88; East N. Y., 38; Detroit, 82; Lillie, 88; Cambria, 140; Hartford, 16; Jackson, 530; Lucy, 80; Grand Rapids, 62; Milwaukee, 102; Rolling Mill, 32; West Rolling Mill, 9; Queen, 47; South Buffalo, 88; Buffalo, 95; Boston, 16; Negaunee, 160; Palmer, 142; Wheat, 42; Ropes gold mine, 62; Lake Superior gold mine, 9; Mich. gold mine, 7; Gold explorations, 40; Furst & Jacobs, stone quarry, 100; Gillett, 43.

IRON.

IRON.

The outlook for the ore mining business is more favorable, apparently, for 1889 than it was at the same season in 1888. The season of 1888 opened with much ore on hand in Cleveland and elsewhere, while now all of last year's product is sold. Prices for ore will remain, it seems, at about the rate of last year, and the cost of transportation will not be varied. At this writing—March, 1889—the feeling among the mining men of Lake Superior is hopeful—much more so than it was a year ago. They all seem to be making preparations for a maximum product. More ore has been mined and put into stock during the winter than usual. Last spring the prospect was so discouraging that as little as possible was doing. It was feared that only a small output could be sold. Later in the season, however, the market became active, and great effort was put forth to retrieve the previous delay. Every ton of ore that could be got out was mined, sold and shipped. Thus profiting by last year's experience, the mining companies are taking time by the forelock, and have made all due preparations for the coming season's work.

One industry depends upon another; in order that iron ore may be sold, there must be activity in iron making—the demand for pig metal must be active; railroad building, etc., must be prosperous. Unfortunately, just now, pig iron is sold very low; the market is dull; furnacemen, while hoping for better things, are stocking the iron, and there is a considerable accumulation that is added to constantly.

Thus there is no silver lining in the horizon of the iron mining industry, but the clouds have not become very dense yet. The sky is partially clear, and if our mining men can sell their ore at even a small margin they will be satisfied, and will try to make up for the small profit by greater skill and economy in working, and by increase of quantity of production.

THE CLEVELAND IRON MINING CO.

is manifesting its usual energy and thoroughness in its work; nowhere are all the details more completely systematized than here, and no mining loca-

tion is kept neater and in better trim than the Cleveland. The buildings and the machinery are of the best, and there is one feature of the surface arrangements that is worthy of observation and imitation, and that is the storage yard. I am not sure as to the name they give to it, but it is simply a large yard, enclosed by a high, tight board fence, against which on the interior is built a shed that extends around the entire perimeter of the yard. All old materials—pipes, machinery, etc., of all kinds—is brought into this yard and kept in its proper place, so that when anything is wanted it is known exactly where it may be found. I do not know of just such an arrangement anywhere else; but everything is in its place and put in order to be immediately used if wanted.

The work at Lake Angeline is progressing finely and the matter of opening a mine under the lake is well advanced. At the time of my visit a force of 150 men was working on the surface grading for stock pile room, yard tracks, etc. The ground rises very steeply from the margin of the lake up to the north, and they are cutting away the side of the bluff and putting the dirt into the edge of the lake, thus widening the flat. They were also framing the timbers for a large shaft house; also for ore pockets and rock pocket. The shaft is sunk in the north margin of the lake inclining down to the south at an angle of 50° with the horizon and is now, February 1, 1889, 350 feet deep and still sinking; at present is in diorite. At the depth of 250 feet, measured along the shaft, a drift has been opened and is still pushing on under the lake. Above this drift are 73 feet thickness of rock, 33 feet of sand, then 47 feet depth of water. In driving south from the shaft ore was found at a distance of 33 feet, and they went through 100 feet of it, the ore dipping south. A diamond drill was put to work from the south end of this drift and after going through 360 feet of rock came into a second deposit of ore, which proved to be of a width corresponding with the first. It is supposed to be the up-turn of the fold to the south, the bottom of the ore basin being away below the cross-cut.

The drift is now extending to reach this ore. The ore corresponds in appearance and quality to that of the Lake Superior Co.'s hematite, mined at the west end of the lake.

It is proposed to fill the mine as ore is taken out and elaborate preparations are making to handle the necessary rock at a minimum cost. One section of the shaft will be used as an ore chute and will be kept full of rock from the surface to bottom. The rock will be drawn out of this chute as required, and trammed to the place to be filled. It is proposed to bring the rock now in the old burrows at the mine in cars to be used for filling.

The mine undoubtedly will be a large producer, though it will be wholly under the lake. The extent of the ore east and west was proved by borings with a diamond drill as explained in my last report. Analyses of the ore, as also shown in the last report, determine that the ore is very nearly Bessemer. It is thought that the south deposit will prove to be a Bessemer ore. Analyses of the drill core all indicate such a fact, and that it is 65 per cent iron. The shaft house will be 46′ 4″x38′ 8″; height from sill to plate, 69′ 8½″—7′ total to ridge. The capacity of ore bin will be 364 tons, in three compartments for three grades of ore.

The Incline pit, once the great producer, now yields but little ore; a small force is kept at work exploring and sinking and at the present time the indications are more favorable. The ore appears to be dipping down and to be making more to the south. At the south end of the pit the ore is hard granular slate.

No. 3 pit contains a great deal of what they designate as "vuggy" ore, a peculiar looking low grade hematite, for which, in such a time as this, there is not much sale, at least not at a profit. It is found mainly in the eastern part of the pit and many thousands of tons could be readily and cheaply mined when there is a sale for it.

The mining in No. 3 is confined to the hard mixed specular and magnetic ore which occurs in the western end of the pit and trends westerly with a southerly dip. They are working in this ore in four levels and in addition a drift extending from the mine into the ground, between it and the Incline pit, is also in this ore. The ore just mentioned was found by the diamond drill. Several holes were bored; the first one between the pits was 405 feet long and cut only jasper, quartzite and soapstone. The second boring immediately under the first cut 30 feet of ore at a depth of 17 feet under the first hole, while a third boring passed through 56 feet of ore at a depth of 22 feet below the second boring where the ore was found. The drift that has been opened from No. 3 to this ore will be continued to connect with the Incline pit.

The Moro pit, the principal hard ore mine of the company, is now down to the ninth level and the shaft is sinking to the 10th, and they are stoping ore in the first, third, sixth, seventh, eighth and ninth levels. The ore is better quality as the mine becomes deeper; that is, it is freer of rock, cleaner. It occurs in lenses that extend into the soap rock and jasper and that ultimately give place to the inclosing rock. There is a rise in the ore 200 feet above the first level, but at this height the ore is not in large quantity. The lenses "pitch" to the northwest while the dip is slightly

northeast. Some of the lenses stand vertical. The mine is looking better, to use a common phrase, than it did a year ago. It is safe to assume an annual production of 100,000 tons with the present outlook.

There are 45,000 tons of ore in stock at the Moro now, and Mr. Mills tells me that during the year ending May 1 next the Moro will have produced 125,000 tons of ore. besides 15,000 tons of rock, all of which must be hoisted in a single skip shaft. Pretty good work, certainly, for one skip running down to a depth of 700 feet.

The ore is specular slate, medium soft, very suitable for "fix."

At the time of my visit they were preparing to finally wreck the old saw mill pit, which is just northwest of the brownstone engine house. It is estimated that about 30,000 tons of first-class Bessemer ore still remain in the mine in the "back" and pillars. This will be mined out. A hole has been made from the surface through the "back" into the opening and through this the dirt will be run down to fill up the mine when the pillars and roof of ore will be stoped away.

The Cleveland holds in common with the P. & L. Angeline Co. a "prospect" for ore that strong hopes are entertained of. It is south of the east end of Lake Angeline near the corner of Secs. 10, 11, 14, 15, T. 47, R. 27. The Cleveland Co. owns east of the north and south section line. Ore has been found of the best quality and they are preparing to make a vigorous effort to ascertain if there is enough of it for a mine.

The Cleveland Company is building two large steel steamers of 2,500 and 2,800 tons capacity respectively. They will be of the most approved design, with triple compound condensing engines that will secure a speed of 14 miles an hour. They are to be, especially, ore carriers and will make the round trip between Superior and Lake Erie ports in six days. The Cleveland is one of the oldest iron mining companies in the State and holds all its estate in fee simple. The officers are Samuel L. Mather, President and Treasurer; William G. Mather, Vice-President; Fred A. Morse, Secretary, all of Cleveland, Ohio. F. P. Mills, agent, Ishpeming, Mich.; Alfred Collick, Mining Captain, Cleveland hematite; Harry Wills, Mining Captain, hard ore mines.

The following shows the annual shipments:

Year.	Tons.	Year.	Tons.
1854	3,000	1872	151,724
1855	1,444	1873	133,265
1856	6,343	1874	105,855
1857	13,201	1875	129,881
1858	7,909	1876	145,661
1859	15,787	1877	151,554
1860	40,041	1878	143,320
1861	11,794	1879	113,108
1862	40,364	1880	187,234
1863	46,842	1881	197,843
1864	49,954	1882	204,341
1865	33,355	1883	218,219
1866	42,680	1884	224,479
1867	75,864	1885	218,632
1868	102,112	1886	203,386
1869	106,133	1887	204,828
1870	133,884	1888	182,733
1871	142,658		
Total			3,882,589

The mine produced more ore than was shipped, as will be seen by the following table:

The Product from Each Pit for 12 Months ending December 31, 1888.

Months.	Incline Pit.	No. 3 Pit.	Moro Pit.	Other Pits.	Hematite.
January	3,538	8,853	4,608	38	1,744
February	3,400	8,022	6,054	46	1,822
March	2,607	6,866	4,517	10	1,721
April	2,160	6,782	5,058	----	2,206
May	618	8,370	7,457	----	969
June	1,333	6,702	7,390	----	1,397
July	1,421	4,284	7,531	----	1,414
August	2,728	3,986	7,831	41	3,441
September	625	5,200	10,904	36	3,427
October	399	5,801	13,893	130	3,102
November	291	4,909	6,998	----	3,232
December	377	5,814	4,931	----	2,862
Total	19,497	75,589	87,172	301	27,337

Total hard ore mine	182,559 tons.
Total Hematite mine	27,337 tons.
	209,896 tons.

THE JACKSON MINE

is an anomaly. It differs from others of the old mines materially. It contains both hard and soft ore in the same pits. The formation is not so easily made out; it is broken jasper and chloritic schist limited on both sides of the basin, north and south, by diorite. The deposits, formerly, were large and of excellent quality of ore, but were comparatively shallow. The location is full of great yawning chasms open to the light and of chambers beneath the surface from which the ore has been taken; but they are all practically exhausted. There is not much ore in sight in the old pits, which were once the glory of the mine. No. 6 is gone and in No. 5 there is only one stope and of that the end is not far distant. Nos. 7 and 8, away to the east with underground workings extending beneath the city, still hold their own and produce about the usual quantity of ore. But No. 7 is non-Bessemer and thus, while good ore, it brings a low price and lessens the profit in mining it.

The South Jackson, over the hill away south of the old mine and west from the McCumber, is in good shape, and will afford its usual product. The mine is now all worked underground and they are opening it out in good shape for the ensuing year's work. There is nothing new about this or the other old pits. I have described them so fully heretofore, especially in my report for the year 1885 and previously, that I do not deem it necessary to dwell upon them further. But the new exploring work undertaken by Capt. Mitchell when he first came in charge of the mine and continued since, is turning out finely.

Some diamond drill borings made west of the old north pit disclosed the existence of ore in quantity and of the best quality, and Capt. Mitchell began the sinking of an inclined shaft to it. This shaft, begun two years ago, is just down to the ore. It proved to be a troublesome job owing to water and sand. A year ago however, at the time I visited the mine, he had just begun to sink a downright shaft which reached to the ore at a depth of 90 feet. Here they are mining in a fine deposit of ore, which is dipping to the west and southwest about 24°. They have gone up north on the foot wall from the shaft 65 feet and west 200 feet. The ore is 16 feet wide at shaft and west but grows thinner up the foot wall north. This ore continues west a long way, probably; since two drill holes made on the line of it west passed through the ore. The one farthest away was made by

Capt. Merry, and he told me himself, nine years ago, that he cut 30 feet of ore. Undoubtedly Capt. Mitchell has got into this same body of ore and is fortunately likely to have a good deal of it. It is, possibly, a part of the fold that underlies the whole basin to the south and the ore may continue with it. At any rate it continues west as proved by the drill holes and it continues north, for the inclined shaft to the north that has been so long sinking, is down to the ore, apparently the same body. This ore is first-class hard specular, Bessemer; 62.50% iron, .040% phosphorus, and proves a great acquisition to the company.

Heretofore no compressor power has been employed at the Jackson; it has been all hand drilling. They have now a Rand compressor at this new shaft nearly ready to work, when they can accomplish more and at less cost.

As before stated the mines of the Jackson Company are not deep. Nos. 5 and 6, the largest, are about 350 feet to the bottom; the ore formation continues and possibly at greater depth more ore may be found. The company employs about 300 men—160 in west pits, 80 at Nos. 7 and 8; Nos. 7 and 8 pits yield about 2,800 tons per month.

Annual products of the Jackson mine are given in the following table:

Year.	Tons.	Year.	Tons.
Previous to 1856 (estimate)	25,000	1872	114,910
1856	417	1873	130,131
1857	12,442	1874	94,708
1858	10,309	1875	87,283
1859	28,377	1876	98,480
1860	41,295	1877	80,340
1861	12,919	1878	83,120
1862	46,046	1879	112,921
1863	77,237	1880	120,622
1864	83,905	1881	118,939
1865	65,505	1882	93,670
1866	92,287	1883	71,278
1867	127,491	1884	76,626
1868	130,524	1885	67,657
1869	125,968	1886	89,525
1870	127,642	1887	109,947
1871	132,297	1888	101,720
Total			2,796,559

Samuel Mitchell, President and General Manager, Negaunee, Mich.

THE LAKE SUPERIOR IRON CO.'S

mines are now confined chiefly to No. 2 hard ore mine, the hematite and Sec. 16, west of the Pittsburgh and Lake Angeline. The No. 2 has formerly been the chief deposit of the company but they are to the bottom of the ore basin, they think, and no sinking has been done for two years. The project now is to take out the pillars and rob the mine. There are 15 levels, the lowest is the 720-foot; that is it is 720 feet below datum. The levels are quite uniform in length, 500 to 600 feet long east and west, and 20 feet to 50 feet wide, and in all of them are heavy floors and pillars of ore, the latter especially, at the shaft. In fact they estimate that 40% of the ore is still in the mine in floors and pillars. The shaft is at the east end of the deposit and descends S. 62° W., while the ore body runs S. 70° E.

In mining out the floors, etc., the plan is to fill the mine with rock, running it down from the surface through a chute that is made by connecting the winzes up through the mine from the bottom, as it so happens that these winzes are in the same line, the one under the other. Rock can be obtained from old waste pits and from walls of the open pits. They are also sinking No. 6 shaft which is just west of the mine, and are both sinking and raising in it at several places. When completed it will be used in hoisting the ore, etc., in this final work of exhausting the mine, that is in taking the pillars from No. 2 shaft. They have already begun to take out the arch of ore or floor in the 640-foot level. They do not begin at the bottom for the reason that it would interfere with the work of sinking, etc., No. 6. They will work from the bottom up, level by level, and make connection with No. 6 shaft at each level. No. 6 was only to the 280; it will go to the 720. The levels in No. 2 began to narrow at about the 560; above that the ore was 50 feet wide.

No. 3 shaft is sunk to the 520-foot level, where the ore terminates—goes into No. 2.

No. 7 is sunk to the 720 and they drove in the bottom from both shafts to connect, which they did exactly, an evidence of Mr. Sturtevant's good engineering. This drift is 920 feet long and a little good ore was found in it. The drift followed a drill hole, which gave in this case a great length of ore, but it proved to be in narrow seams. All the machinery at No. 7 is idle. The water now goes to No. 2 where the pumping plant is sufficient for this addition and the hoisting is done there for No. 7. It looks as if it will be difficult for the mine to make its usual product. There are not many stopes in any part of the hard ore mine and the proposed plan of

mining floors and pillars, one level at a time, will not furnish ore rapidly.

Section 16 mine is not very large yet, and so far as they have been able to determine is not likely to be of great magnitude. It is good ore, however. The deposit is in dimensions about 200 feet east and west, and 150 feet north and south. They bored two drill holes from the bottom south—one horizontal 600 feet, the other at 12° depression—one 500 feet long and had in it 29½ feet of ore. Borings made also to the north and west cut considerable ore, but except near the mine the ore thus found is low grade. The mine furnishes ore that gives a percentage of 68% in iron and is low in phosphorus. Still the product of this mine is not all Bessemer, but it is all specular ore. About 200 tons per week of Bessemer and 600 to 800 tons non-Bessemer. The mine is well equipped with machinery, placed in a stone engine house. The bottom level is 350 feet below surface, and the shaft is sunk 80 feet below that depth. The ore extends 70 feet west of shaft and 90 feet east of it. In the upper level the ore is all taken out, and the space filled with rock, except some necessary openings left. In the bottom level they have gone up 2 sets high. They will mine out all the ore and fill, following the same system as in the hematite. Thus far the rock for filling has been supplied by the shaft sinking and rock drifts, etc. Mine employs 40 men.

The exploring west of the old Lowthian on section 21 is still in progress. The shaft is 200 feet deep and in ore, but not a high grade ore—61 per cent and non-Bessemer. At a depth of 140 feet, they drifted 130 feet west, and also a lesser distance east. The exploring work will be continued.

The Lake Superior Hematite is the most valuable mine that the company possesses at present. I have fully described it in former reports and do not find much of anything new to offer about it. It will be remembered that the ore lies in a synclinal fold—in a trough of the formation—in a belt between the jasper underlay and the overlying quarzite. The deposit is all ore in the bottom, but as it rises up on each side of the fold it separates and becomes the north and the south vein. The deposit terminates at the west end against the foot wall, and the bottom of the fold inclines downward, slightly, as it extends east. There are two shafts, 360 feet apart, both to the 444 ft. level. But in No. 1, the east shaft, there is no ore below the 400. In fact scarcely any below the 360. The mine has been extended a long way east, clear to beneath the margin of the lake. The system of mining works admirably, and differs from that practiced anywhere else in the region. They mine the ore out in sections across the deposit, each section 21 feet wide, leaving pillars between. The rooms thus formed are timbered in "sets," after the usual Nevada system; but there is this peculiarity: the rooms are filled with rock as fast as the opening work proceeds. Each room

is three sets wide, the middle one of which in the lower sets is kept open for tracks to run the ore down into cars. When the lower sets of a room are in they rise up for the other sets on top of the first, and while the third rise is made the lower ones are filled. And when making the 4th, the 2d rise of sets are filled, and so on, the filling coming down from above and the ore going down through the mills into the chutes below. In this way the rooms are all filled wherever they are made, and the mine is as solid as before. No pillars have been taken, except west of No. 1 shaft where the deposit was comparatively small. When the pillars are attacked the work will proceed in the same manner as now and with the same facility and safety.

The management at the Lake Superior is unquestionably excellent and the company is fortunate in having so experienced and faithful mining captains as are Messrs. John McEncroe and James Trebilcock, of the hard and soft ore mines respectively, and it would be hard to find a mining engineer who performs his duties better than does Mr. H. B. Sturtevant. The company proposes to load its ore with a steam shovel.

Year.	Tons.	Year.	Tons.
1858	4,658	1874	104,311
1859	24,668	1875	119,335
1860	33,015	1876	110,570
1861	25,145	1877	127,349
1862	37,704	1878	104,674
1863	78,976	1879	174,747
1864	86,773	1880	204,094
1865	50,201	1881	252,235
1866	68,002	1882	296,504
1867	114,935	1883	200,799
1868	105,745	1884	204,796
1869	125,560	1885	226,040
1870	166,582	1886	268,035
1871	158,074	1887	302,909
1872	145,070	1888	241,225
1873	158,428		
Total			4,380,222

The product of 1887 is made up as follows:

Hard ore, No. 1	135,494 tons.
Hard ore, No. 2, (2d class)	3,540 tons.
Hematite	101,191 tons.
Total	240,225 tons.

Joseph S. Fay, Treasurer, Boston, Mass.; C. H. Hall, Agent, Ishpeming, Mich.; W. H. Johnston, Superintendent, Ishpeming, Mich.; H. B. Sturtevant, Mining Engineer; John McEncroe, Captain hard ore mines; James Trebilcock, Captain hematite mine.

THE PITTSBURGH AND LAKE ANGELINE CO.

has probably made more money the past year than any other iron mining company in the State. The ore is of such excellent quality that it brings the highest price in the market, and since the company owns the fee of the mine it has no royalty to pay and so whatever is left over and above the cost of mining, etc., is profit to be divided among the stockholders.

The west end of the mine is hard specular ore, the east end soft ore. The latter is opened to the sixth level and the former to the seventh. But in the east end not much opening has been done below the fifth. They started "to room out" in the sixth but the ground would not hold up. I went through the mine but it is all crushed down to the fifth level, so there is not much to see except the drifts and the places where they are "drawing the ore" from the pillars. The levels are 50 feet apart and the "opening work" consisted in cutting out rooms in the ore, from the main drifts in each level, three sets wide and six sets high and timbering them after the usual manner. Between the rooms pillars of ore were left of the same width as the headings and also an arch of ore over the timbers to form a floor for each level. In this way it was thought a sufficient stability was secured to keep the mine intact, but it proved otherwise; the ore is very soft and the pillars would not sustain much pressure. Added to this some poor engineering in the matter of laying out the rooms caused some of them to be so placed that they did not come under one another. Altogether it was found that the ground would not hold. Capt. Walters tells me that he mined out the floors between the pillars and allowed the overlying sand, etc., to come in and fill the rooms and is now mining out the pillars of ore that were left standing. He states that he is losing but very little ore. He says that the pillars are not spread out laterally; the sand, etc., in the rooms does not mix with the ore to any appreciable extent. There is no other mine in just the peculiar condition that this one is, but they understand it and have to adopt ways suited to each portion of the mine.

The mine in the second level is 1,900 feet long and goes to near the line west. The ore in the second level goes 200 feet west of C shaft, and in the third level 250 feet, and so on, each level lengthening west about 50 feet.

They hoist from four shafts, A, B, C and D; the latter is the one furthest east, being 1,700 feet east of the west line, the ore going 200 feet further east.

C shaft in the west end of the mine, is sunk in rock, and has two skip roads, ladderway and timberway. The hard ore is in two lenses, so called; a small one on the foot wall side is non-Bessemer. The hanging wall lense is larger and the ore is Bessemer. In the third level this lense is 400 feet east and west, and is 120 to 140 feet wide, greatest width, while the non-Bessemer lense is about 140 feet long by 100 feet wide. But in the fourth level the dimensions are smaller, the greater lense being about 280 feet x 120 feet. In the 5th level the ore is 130 feet long and 3 sets wide.

The diamond drill is boring in this end of the mine with varying results, not extremely encouraging so far.

A new "find" of ore has been recently made nearly a mile east, at south-east corner of the section, near the line between the P. & Lake Angeline Co. and the Cleveland Co.'s lands. The ore found is equal to the best, and it remains to discover how much there is of it—a matter that the company is taking steps to determine.

The Lake Angeline mine, owing to the quality of its ore, is regarded as one of the very best of our iron mines.

The ore, in 1888, sold for a higher price, I think, than any other in the market, and I have reason to believe that the company paid a larger dividend than did any other iron mining company in Michigan. The first class ore averages 67 per cent to 68 per cent in metallic iron, and not above .030 per cent in phosphorus.

The following shows the product of 1888:

Lake Angeline hematite (Bessemer)	89,197	tons
South Angeline hematite (non-Bessemer)	14,870	"
No. 1 hard ore (Bessemer)	84,888	"
No. 2 hard ore (non-Bessemer)	31,675	"
Total	220,600	"

A pretty good showing for an old mine that was seemingly exhausted a few years ago. Fortunately it is in wholly new ground; in ore not far from the old workings, which was easily reached, and which has proved to be so very valuable, transferring the Lake Angeline from its former position as one of the poorest in the region to a foremost place among the mines that head the list.

The Pittsburgh & Lake Angeline Co. owns its mine in fee simple, and also holds in like manner other valuable lands near by.

Annual Products.

Years.	Tons.	Years.	Tons.
1864	19,500	1877	19,113
1865	20,151	1878	28,161
1866	24,073	1879	25,420
1867	46,607	1880	14,794
1868	26,651	1881	18,000
1869	39,644	1882	14,518
1870	53,467	1883	27,259
1871	33,645	1884	87,018
1872	35,221	1885	111,051
1873	43,933	1886	131,384
1874	30,499	1887	191,121
1875	30,281	1888	220,600
1876	22,589		
Total			1,314,761

A. Kidder, Agent; Thomas Walters, Supt., Ishpeming, Mich.

THE BARNUM MINE,

which for many years has been worked just north of the line which separates it from the Lake Superior Company's No. 3 mine, shows very little change for the better or worse. The company still follows the same deposit of ore west, and close to the line, and obtains from it annually the same product. The ore is of very good quality, first-class specular, non-Bessemer. The mine belongs to the Iron Cliff Company, one of the largest mining corporations in the State, that owns an estate of about 40,000 acres of land, being a portion of the original grant of the government for building the canal at the Sault de Sainte Marie and acquired by purchase of the grantees. On the opposite side of the valley to the north is the more important mine owned by the same company and now called

THE CLIFF.

This is now one of the best equipped mines in Ishpeming, for it is right in the city and the underground workings extend easterly, probably, as far as the Nelson House, which is in the central part of the city. There is no danger to be apprehended from this fact, however, since the openings east are not thus far very extensive and in any event they are 400 feet below the

surface, beneath the great body of overlying quartzite that is remarkably firm, entirely adequate, with suitable pillars, to sustain the surface.

I notice some changes at the mine that are of value; as for instance the sheaves over which the cage ropes were run in the shafts were seven feet diameter; these have been taken out and others of 12 feet diameter substituted, which are found to work far better—less wear on the ropes.

The old hoisting plant has given way for a new one and they now have new Merritt drums 10 feet in diameter that work excellently. A new boiler house has been built and three fine steel boilers added, making the entire number now nine. The shaft houses are kept warm by steam pipes so that I observed on a cold day when I happened to be at the mouth of "A" shaft that it was comfortable. Each shaft has a single cage and no counterbalance is used. A horse is employed at "A" shaft to draw the cars from the cage out to the stock pile.

The buildings at the Cliff mine are mostly of stone with iron roofs and are commodious and substantial. Among the changes in the past year is a new office, also of stone.

The empty car goes behind the cage and is moved sideways to stand opposite it and when the loaded car is drawn off an empty one follows it on and is lowered down the shaft. It is done quickly; there is little delay.

The Cliff is a safe, well ventilated mine, and is well managed; men who work there like the mine and the officers and there are few changes among the workmen.

It will be remembered that the mine is in a fold of the formation, the axis of which runs east and west. The ore deposit constitutes one of the folds of the formation and is underlaid by jasper and covered by quartzite. The shafts, which are 835 feet apart, are sunk vertically to a depth of 472 feet, to the bottom of the fold. The workings extend all the way between the shafts and to a considerable distance east of A and west of B. At these extremes the formation is less regular and the ore is displaced by jasper far too much to be profitable. Generally, throughout the mine, there is too much jasper in the ore. They have had trouble ever since the mine was opened with the jasper. It comes in to destroy the stopes or to injure the quality of the ore.

Thus far the stoping is all above the bottom in the upturn of the fold to the north. In the first level the ore, instead of continuing its inclination upward, goes off flat to the north and opening in this horizontal portion of the fold proves to be the best ground I have seen in the mine. I visited the mine in February, 1889, at which time I found that at a point 400 feet west of A shaft, in the upper level, they had begun to room out to the

north. The first room was in 300 feet, and the stope at the north end was 18 feet high. The ore is quite clean, hard specular. The sides, roof and angles of intersection are smooth and sharply defined like those of a room; in this respect the appearance is remarkable. Another room had been started and was driving parallel with the first and 30 feet west of it; in all respects it appeared to be a duplicate of the other.

They expect to mine a larger product this year than usual and that the ore will be of better than the average quality for this mine.

The old Barnum produced in 1888 10,211 tons of ore and the Cliff shaft 78,520, making a total of 88,731 tons.

The Barnum and Cliff are among the mines of the Iron Cliff Co.

The Cliff and Barnum have produced each year as follows:

Year.	Tons.	Year.	Tons.
1868	14,386	1879	24,911
1869	37,503	1880	24,921
1870	44,793	1881	27,281
1871	45,939	1882	41,424
1872	38,381	1883	62,752
1873	44,368	1884	67,782
1874	40,255	1885	47,458
1875	40,914	1886	82,686
1876	37,750	1887	95,586
1877	38,314	1888	88,731
1878	26,680		
Total			973,060

Wm. Sedgwick, Superintendent, Ishpeming, Mich.; Tom Barge, Clerk, Ishpeming, Mich.; Alex. Maitland, General Manager, Negaunee, Mich.

THE PIONEER

is also one of the Iron Cliff Co.'s mines, situated in the N. W. $\frac{1}{4}$, S. W. $\frac{1}{4}$ Sec. 4, T. 47, R. 26, being east of Negaunee in the range with the Buffalo, etc., mines. It is simply an open pit mine near the section line and, I judge, has been practically exhausted. However there were shipped from it in 1888 8,712 tons of ore making a total of production of 13,852 tons.

THE FOSTER

is another one of the Iron Cliff Co.'s mines which has been operated since 1865. The mine is in the company's lands in Secs. 22 and 23, T. 74, R. 27.

The product is rather of a low grade non-Bessemer hematite ore, about 53% to 55% in metallic iron and .094% phosphorus. It is used at the Pioneer furnace, Negaunee, Mich. In 1888 there were mined 13,000 tons and the total product since 1865 is 167,336 tons. Alex Maitland, General Manager Iron Cliff Co., Negaunee, Mich.

THE NEW YORK IRON MINE

situated in the city of Ishpeming, and being close to the Cleveland mine, has not been worked for several years. The mine was formerly a very valuable one, and was the source of large profit to its owners, but so far as known now there is not, comparatively, much ore left in the mine.

There were shipped from the mine in 1888 11,480 tons of ore, and the aggregate product amounts to 1,051,149 tons.

L. McCloskey, Gen'l Supt; August Beerling, Supt. at mine.

THE EAST NEW YORK IRON CO.'S

mine adjoins the Cleveland and New York mines, being east of the latter and north of the former. The ore is hematite, and as far as I can judge, runs about northwest and southeast, lying between the two shafts, which are east and west of each other, about 500 feet apart. A knob of jasper that rises abruptly marks the point where much exploring has been done, and near which the ore is found. The shafts are just south of this knob—one near each extremity.

No. 1, the southwest shaft, is 90 feet deep, and the drift is north through the ore. East of the cross-cut drift they have cut out several rooms—each two to four sets high and three sets wide.

No. 2 shaft, on the southeast corner of bluff, is 100 feet to 1st level, and they have drifted from the shaft south 200 feet, first through 40 feet of rock, thence in ore. The shaft is 50 feet deeper, to second level—in all 150 feet deep, at which depth they are also drifting, both to south and to north. East of the bluff is a swamp, and south is a valley 600 feet wide, terminated by a diorite hill. The shafts are both small; only buckets are used. No. 1 being so far away to the south of the ore, will not be sunk any deeper, but a third shaft will be located and sunk. The drift from No. 1 north passes a length of 75 feet diagonally through the ore deposit and again reaches into ore north of the jasper, 500 feet from the shaft in the level land beyond.

The indications are favorable that at greater depth the ore will become cleaner—that is, be freed of the rock that to some extent is now mixed with it. I have seen no analyses of the ore, but am told that it is Bessemer, and

about 60 per cent in iron. As now mined the ore requires considerable picking over to make it merchantable.

The drift north at the 100 ft. level in No. 2 shaft was in ore at 60 feet north of shaft, probably the same ore cut in the end of the drift north from No. 1.

The machinery consists of two drums, each 3½ feet in diameter; a 16 horse power engine, a No. 8 Knowles pump; 2 boilers. Work now 55 men.

The mine produced in 1888, 13,650 tons of ore.

W. H. Johnston, Agent; Geo. Bodenne, Mining Capt., Ishpeming, Mich.

The force employed at present time—January, 1889—is 60 men. The estate consists of 160 acres, held on a lease.

THE AMERICAN,

formerly the Sterling mine, while not as yet a large mine, has such excellent specular slate ore that in any event the mine is worth every effort to explore. But in fact ore in fair quantity is known to exist in the mine, and they are sure to get into it in time. Even now the mine is looking well, and the ore deposit is increasing in size. An investigation into the cause of a bulge in the foot wall, recently, led to the discovery of a lense of ore, at first only a foot in width, but now, having been followed some distance, it is eight feet wide. This may be the same lense of ore that was cut with the diamond drill some years ago, further west, as explained in a former report.

The shaft is 300 feet deep, and they have gone west from the line 340 feet. The company has leased the Boston, which joins it on the west, and which has been idle for four years past. The mine is in the S. W. ¼, S. W. ¼ Sec. 32, T. 48, R. 28, being about two miles north of Clarksburg.

There were mined and shipped in 1888, 13,670 tons of ore, 860 tons of which were taken from the Boston mine, making the total output 28,812 tons.

The company has a sufficient hoisting equipment for all present needs, and the using of the Boston mine compressor and air drills makes the full complement of machinery. The formation here is a typical one, being identical with that at the Champion and the best hard ore mines.

The officers are: C. R. Ely, Secretary and Treasurer; Wm. H. Johnston, President, Ishpeming.

THE BOSTON MINE

which joins the American on the east, is owned in fee simple by the company; the estate comprising 80 acres. The mine has been so fully described in

former reports that no description will be given here. It is a well equipped mine—machinery, buildings, etc. The formation is very regular, and all the geological features are favorable.

The mine has been idle for several years, and is now leased by the American, which company took out of the Boston, through the American shaft, 860 tons of ore in 1888. So that the mine has yielded in toto, 62,575 tons.

S. L. Mather, President, Cleveland, Ohio.

THE NONPAREIL,

formerly the St. Lawrence, has not been operated in 1888. The ore is of poor quality and not worth mining at present prices. It is situated northwest of Ishpeming in the N. W. ¼ Sec. 5, T. 47, R. 27. John R. Wood, Agent. The mine has furnished 23,171 tons of ore.

THE DEXTER CONSOLIDATED MINE,

being in the E. ½ N. E. ¼ and W. ½ N. W. ¼, Sec. 3, T. 47, R. 28, is working still, but not with very brilliant prospects of mining success. The work is almost wholly exploratory, and as the rock is very hard, slow progress has been made; now that a new Rand compressor, 15x30, and four power drills have been added recently, much more can be accomplished. The mine holds lean hematite in considerable quantity and also some fine hard ore is found; but scarcely enough of it yet. The formation is jasper underlaid with quartzite or kindred rock, the reverse of their usual positions. The product in 1888 was 1,821 tons thus making a total to date of 26,360 tons.

F. O. Clark, Agent, Marquette, Mich.; Thomas Walters, Superintendent, Ishpeming.

THE NORTH CHAMPION IRON CO.

has operated its mine in the E. ½ N. E. ¼ Sec. 29, T. 48, R. 29, one mile north of Champion station, and produced 5,685 tons of ore. The quality is 55 to 59 per cent in iron and .18 to .21 per cent phosphorus.

The company restricts its mining work to its ability to sell the ore. No doubt a far greater amount of ore could be produced if a market for it could be found. The mine was opened in 1887, during which year 883 tons were sent out.

S. Brownell, General Manager; Henry C. Hart, President, Detroit, Mich.

THE MAT GIBSON,

N. ½ S. E. ¼ Sec. 29, T. 48, R. 29, has produced no ore in 1888. Total product in previous years, 16,357 tons.

Mat. Gibson, Superintendent, Republic, Mich.

THE PASCOE IRON CO.,

holding S. ½ N. E. ¼ Sec. 29, T. 48, R. 29, still remains idle. It was formerly the most conspicuous of the north range mines; has yielded in all 58,667 tons of ore.

D. H. Merritt, President, Marquette, Mich.

THE PHŒNIX IRON MINING CO.,

holding the lands next west of the Pascoe, has not worked its mine during the past year. Total production in previous years, 54,114 tons.

Peter White, Esq., Agent, etc., Marquette, Mich.

THE WETMORE MINE,

in the N. W. ¼ Sec. 25, T. 48, R. 31, west of the village of Michigamme, has been worked in a small way the past year, corresponding with the work in former years; 2,115 tons of ore were taken out. A very full description of this property will be found published in the Commissioner's report for 1886. Total production, 31,221 tons.

E. A. Wetmore, Agent, etc., Marquette, Mich.

THE WEBSTER MINE,

which joins the former on the west, presents nothing new to record. The mine has not been worked in 1888. Total shipments to date, 14,668 tons.

In my last report I described quite fully some exploratory work that had been done by Mr. J. C. Fowle, of Michigamme.

The properties in which this work was done are the S. ½ S. W. ¼ Sec. 23, T. 48, R. 31, and the S. ½ S. E. ¼ Sec. 22, T. 48, R. 31, owned by the Michigan Iron & Land Co., and held on an option or lease by Mr. Fowle. Since no further work has been done, my previous description covers all, I think, that is necessary to be said.

THE NORWOOD,

however, the next 80 west, being the S. ½ S. W. ¼ Sec. 22, T. 48, R. 31, being in a much more advanced state of development, is made to produce ore for shipment. There are two shafts, 50 feet deep. A total of 5,753 tons of ore have been mined and shipped. The ore is of the same kind and quality as is found in the other mines of this range—55 per cent to 60 per cent iron, and .15 to .25 per cent phos.

J. C. Fowle, Agent, etc., Michigamme, Mich.

THE BEAUFORT MINE,

lying west of the Norwood, in the W. ½ N. W. ¼ Sec. 22, T. 48, R. 31, has been so frequently described and so little worked of late, that there is not much of interest to mention beyond what has been formerly said. The mine produced in 1888, 8,282 tons of ore, making a total to date of 97,848 tons.

H. S. Hazelton, Secretary, 151 Insurance Building, Milwaukee, Wis.

THE TITAN

joins the Beaufort on the west. The division line passes through the workings. The mines are similar, and the ore is the same. If the ore were of salable quality a large amount could be mined. Both mines are well equipped with machinery and buildings. The Titan yielded in 1888, 2,845 tons of ore, making the total product 89,513 tons.

S. S. Curry, Secretary, Milwaukee, Wis.

THE SPURR MINE

remains idle. The company owns the fee of the land—N. ½ S. W. ¼, S. ½ N. W. ¼ Sec. 24, T. 48, R. 30.

SECTION 23

joins the Spurr on the west, and a mine in it, formerly known as the Stewart, was worked a little ten years ago. As explained in my last report, Mr. J. C. Fowle was then engaged in further exploring the property, in the vicinity of the open pit. He had found ore in the foot wall and had sunk pits further west and ascertained that the ore continued—hard, granular ore, 65 per cent in iron and and .27 per cent to .30 per cent phos.

Mr. Fowle, who holds the lease of the land, has a few men at work at the present time.

From section 23 east to Michigamme lake, a distance of three miles, is a strong magnetic ore formation.

THE MICHIGAMME CO.

may be congratulated on the improved appearance of the mine, for it is really looking better than it has at any time for several years.

The mine is situated in the southerly side of the hill north of the west end of Lake Michigamme.

No. 1 shaft, the most easterly one, is 500 feet west of the lake margin and thence to No. 7, the most westerly shaft, it is 2,800 feet; at about midway

is No. 4, which has always been the most important part of the mine. No. 4 has yielded the best ore and the most of it. At present the main part of the ore that is mined comes from No. 5, the next shaft west of No. 4. In point of fact the best stope is away west of No. 5, below No. 6.

No. 5, 6 and 7 shafts were the first ones made in the mine, but at a limited depth they were abandoned, as the ore was too jaspery and of too small quantity. But the workings that have extended west from No. 4 beyond No. 5 to No. 6 are at much greater depth than was ever penetrated through the shafts proper, and are in wholly new ground which at the present time is yielding well. What is now designated as No. 5 lies 120 feet north from the west end of No. 4 pit and is reached by cross-cuts from No. 4, also by a new No. 5 shaft sunk from the surface on the foot wall of this lense. The lense, unfortunately, proved to have too much rock mixed with the ore; it was impossible to get a stock pile wholly free of rock and for this reason the ore proved unsatisfactory. This has been the case since the ore was opened into in 1882; but now at 600 feet west of No. 5 shaft, 450 feet below the surface, the ore is 14 feet wide and entirely clean. In going west in the 450-foot level they encountered a crossing of soap rock that cut off the ore completely. The ore up to this point had not proven first-class, but on putting in a drill and boring through the barrier they found first-class ore. The stope in this level is 60 feet high and there is the most complete separation between it and the quartzite hanging. The hanging is smooth and sustains itself well. The dip is here about 50 degrees. In the level above they are 100 feet further west in this ore and it is seen to be equally good; as clean and good ore as they have ever had in the mine. The section of this body of ore is lenticular; it comes to an edge at the lower and upper limits, making the longer axis 130 feet, the shorter 14 feet. It laps the lense of ore that they have east of it. The two stopes furnish now (February, 1889,) 150 tons of ore per day. The levels are 100 feet apart; the lower stope goes up 60 feet and the upper stope thus begins 40 feet below the level and extends up to the limit of the ore. An inclined track extends down to the bottom of the stope and a skip running on it brings up the ore and dumps it into a tram car whence it goes to the shaft. A small drum at the head of the incline operates the skip. The drum is worked with a compressed air engine.

They need to make connection with No. 6 shaft to hoist the ore in it and save the long tram to No. 5, to which it all now goes. The ore analyzes 65 to 68 per cent metallic iron.

In addition, the outlook at the bottom of No. 4 is improved; that is, a diamond drill boring from above penetrated what is thought to be a body of

ore, 200 feet below and off in the hanging wall. The shaft has been sunk to this ore and they have crossed it, eight feet wide, and sunk a winze in it ready to stope. No. 4 shaft is now about 750 feet deep; it is a very crooked shaft, the irregular line having been brought about by reason that the ore has "made off" more and more into the hanging wall and the shaft has been "angled out" to reach the ore. The Michigamme mine has a good deal of second-class ore: that is, ore with a slight mixture of hornblende, which does not sell very well. In 1889 the mine will yield more first-class ore than it has in 10 years, in any single year.

At No. 3, is a pit, from the surface, from which ore was mined last summer and which is now sinking for further stoping.

They sunk 40 feet in the bottom of No. 2 and had some good ore but it pinched out. I think No 2 pit is a good place to put a drill to work.

The mining force employed is 80 men, and the cost of mining, tramming, etc., is, in No. 5, $1.75.

All the machinery, etc., remain as I have heretofore described them.

The company holds its estate, which is a large one, in fee simple. The affairs are well and economically managed.

J. C. Fowle. Supt., Michigamme, Mich.; Geo. Orr, Mining Capt.; W. H. Barnum, Pres., Lime Rock, Conn.; James Rood, Sec. and Treas., Chicago, Ill.

The annual products have been as follows:

Year.	Tons.	Year.	Tons.
1872	141	1881	57,115
1873	28,966	1882	43,712
1874	45,218	1883	42,533
1875	44,756	1884	28,757
1876	20,074	1885	12,372
1877	28,238	1886	48,805
1878	58,622	1887	51,975
1879	56,935	1888	36,448
1880	52,944		
Total			604,311

The estate covers 1,400 acres of land.

THE CHAMPION IRON CO.

It is pleasant to find the Champion mine looking so well. It is one of the best mines in the country, one of the largest producers, and the product is of the highest grade of hard ore—specular slate and magnetic.

The Champion ore has long been a standard of quality in the market—no ore sells at a higher price; in fact it is generally considered that the Champion ore heads the list, together with the Republic and Lake Angeline. These three mines, every season, head the scale of values of the ores produced in this State.

And that this high standard of quality shall be retained, no pains is spared at the mine in the sorting of the ore. All the grades are kept fully equal to the quality guaranteed, and there is no grumbling from the consumers.

The ore is all Bessemer, and is divided into four grades; but the greater portion, as it comes up from the mine, needs no sorting, being taken from stopes of a uniform quality of ore, it goes directly to the stock pile as first or second-class ore.

The ore that needs to be picked over is dumped near the shafts, on what are designated as "sorting floors," where it is skillfully sorted by men who have acquired experience in this line of work, and the several kinds run out to the stock piles representing the different grades. The first grade averages, from many analyses which I have seen, 67 to 68 per cent in iron and .040 per cent phos., 1.50 per cent silica; second-class, about 64 per cent; third-class, 61 per cent; fourth-class, about 58 per cent.

The Champion mine has long been a favorite with the people in the Upper Peninsula, as its ore has ever been a favorite one with the furnacemen. It is such surprisingly good ore, and the mine has been so long a uniformly regular producer, the formation is so comparatively regular, the occurrence of the ore from year to year so comparatively unvaried, the management so intelligent and popular, that the Champion has thus done much to establish and sustain the reputation of the district and to keep the good will of the people.

The Champion mine location is one of the pleasantest in the mining region. It has a neat, well kept, prosperous appearance. The streets and sidewalks are excellent. The dwellings, public buildings, yard fences, etc., are all in good repair, and the situation from its elevation commands a wide prospect over the surrounding country, which includes the large and beautiful Lake Michigamme to the west. A population of 2,500 people, living indirectly from this mine, enjoys almost every advantage that the most fortunate communities anywhere possess. There is a fine graded school build-

ing in which the best of instruction is provided. Three church edifices, a large and well furnished hospital, a public hall, public reading room and library and many minor things tending to promote the comfort and advantage of the people. And no employés of the mine, no persons living on the location, except the merchants, pay any taxes except the poll tax; the taxes are all paid by the company. The full and free enjoyment of such advantages ought to, and doubtless does, make a community patriotic, for nowhere else in the world, except in this our own broad land, are they meted out in such bountiful measure to a purely laboring population.

Heretofore, for two or three years past, in going down through the Champion mine, I have involuntarily contrasted the great empty spaces which have resulted from the removal of ore in past years with the comparative smallness of the more recent stopes, and have felt almost ready to conclude that this mine was nearing the end of its existence. But one receives a different impression now. The mine is more fully opened than I have seen it for a long time, and the development has given a far more hopeful aspect to its future.

There have been some new discoveries of ore down in the mine that greatly enhance its value and give the assurance that the mine can make an output the coming year fully equal to any it has ever yielded. These discoveries of ore have come easily, too. The company has not had to do as much of so called dead work in proportion to the results attained as is generally necessary in most other mines. They find the deposits near by to the north, or to the east or west by boring with a diamond drill placed down in the mine at the point to be explored, and when the ore is discovered a short drift through the rock reveals the hidden treasure.

The formation at the Champion is distinguished for its regularity. The strike and dip of the rocks at the mine are scarcely varied. The former being east and west and the latter about 80° to the north. The ore bodies consist of several lenses, so called, that lie one above the other and side by side, dipping north with the formation and lengthening to the west and shortening on the east. Those lying side by side are designated as the north and south deposits, on the foot wall of the latter of which the shafts are sunk, and at each level the deposits are connected by short cross cuts through the intervening rock. These deposits of ore in the upper levels, or in the main body of each deposit, were very wide but at greater depth, as the lower point of the lense was approached, the stopes grew narrower and sometimes of diminished purity, so that confined to the old deposits the mine has become smaller in a sense. To keep up the product and to secure a prosperous future to the mine it was necessary to probe the ground a little

more vigorously in advance of the stoping. For years it was only necessary to sink Nos. 2, 3 and 4 shafts a lift and the ore was at hand for the season's product. That time has gone by; they have had to explore the ground more fully and fortunately have been rewarded for their labor by finding ore in good quantity.

There are seven shafts, in all of which they were working. Commencing at No. 2, the most easterly one, and B shaft, immediately south of it, they are numbered in succession to the west. In all of these shafts, which descend to the north at about the same angle of 80°, the ore lengthened to the west and shortened on the east, so that in time No. 2 shaft was in rock and the ore had gone away so far to the west that it was all reached by No. 3 and No. 2 was abandoned. The same became true of No. 3—the ore was all west of it and east of No. 4, and No. 5 was sunk down and is now producing the most ore since they are stoping in all the levels from the 8th down to the 15th. The 8th, 9th, 10th and 11th are worked west so far as to be under No. 6, which latter is sinking to get into this ground and from which to explore and develop that which lies still further west, a still undetermined portion of the mine. It is of this ground lying west of and under No. 6 that great hopes are entertained—expectations to which, judging from the results that have obtained from sinking No. 5, I am willing to accord full credence. A fact worth mentioning, which I observed in my recent examination of the mine, is the occurrence of an eruptive dike which cuts the ore and was first encountered in the 11th level, 400 feet west of No. 5 shaft. The thickness of the dike is about 18 feet, and the ore is again found west of it. No. 5 is sunk to the 16th level but not much stoping has been done below the 11th. Nos. 3 and 4 are to the 17th, upwards of 1,000 feet deep. In the latter, in the 14th level, a "find" has been recently made—a body of black ore a little way in the hanging which proves to be important, since it has considerable width and is altogether new. In Nos. 3 and 4 there are stopes of ore in all the levels from the 11th to the 17th.

One of the most promising discoveries recently made in the mine is in the 13th level east of No. 3 shaft to the north in the hanging, where they have opened into a body of ore 30 feet or more in width, which extends eastward and apparently upward into the unexplored ground that lies under No. 1 and No. 2 shafts. It indicates that there may be ore in this ground which will cause the sinking of these shafts to reach it. Just now they are working in No. 2 shaft in ore that has been found in the upper levels in west and south of the shaft. Altogether the mine is looking exceedingly well. It is well opened, and there are many stopes of ore and some new finds that gild the horizon of the future.

One very important improvement has been made in the skip tracks. Above each rail, in all the shafts in the mine, has been placed a safety stringer; just far enough above—quarter of an inch—so as not to interfere with the wheels of the skips, but so that they cannot get off the track. The men can now ride in the skips with comparative safety, as they cannot get off the track nor dump in the shaft. But further than this the company has constructed a car to be run in No. 4 shaft in which to carry the men. It is 14 feet long, and will hold, it is estimated, 16 men. On each side of the rear end is a pair of safety clutches so fixed as to grip the upper stringers and stop the car if the rope should break or other similar misfortune occur.

I observed also an improvement in the manner of setting the gates at the levels. Formerly when the skip was up and it was desired to hold it at any level to receive its load, the "gate," consisting of a piece of timber placed across the shaft to support the skip and far enough down to have the mouth of the skip even with the platform, was swung into place by a long lever standing upright directly in front of the shaft; the man taking hold of it pulled backward towards the shaft; once a lever broke, and the tender barely saved himself from being precipitated down the shaft. This led to a modification, due to the ingenuity of Capt. Cundy, that makes the operation far simpler, and eliminates the element of danger. The gate timber moves over and back, describing the arc of a circle, and is counterbalanced with a weight that makes the operation of moving it easy. This is done by simply raising or lowering a lever that comes up through the floor. The company has now an independent pumping plant which brings all the water in the mine up No. 3 shaft, using simply an 8" Cornish plunger pump. Formerly the pumping was made an additional task for the hoisting machinery to perform. The independent hoisting machinery for underground sinking, etc., which I mentioned in my last report, is liked very much, and is esteemed to be of great advantage in expediting the shaft sinking work.

The walls are so nearly vertical, and the overlying quartzite so firm, that comparatively few pillars are required, and so little timber is used as to be scarcely noticeable.

Wood is used altogether for fuel; it is obtained from lands south of Lake Michigamme, being brought in scows to the dock at the foot of the incline, when it is hauled up to the mine on cars propelled with rope running over winding machinery.

The Champion has produced as follows:

Year.	Tons.	Year.	Tons.
1868	6,225	1879	93,203
1869	21,535	1880	112,410
1870	73,161	1881	144,025
1871	67,538	1882	157,516
1872	68,402	1883	104,960
1873	72,782	1884	208,156
1874	47,097	1885	173,914
1875	56,877	1886	137,593
1876	66,002	1887	146,330
1877	70,883	1888	174,681
1878	73,764		
Total			2,076,896

W. E., Stone, Treasurer, Boston; A. Kidder, General Manager, Marquette, Mich.; Walter Fitch, Superintendent; James Cundy, Mining Captain.

THE HUMBOLDT IRON CO.

has been almost continuously exploring with a diamond drill, but the hoped for success has not been met with. The formation is a very peculiar one and it is difficult to satisfactorily interpret it. As mentioned in my last report they were then drilling near the county road, southwest of the mine. The drill was pointed southwest; are now boring at same place with the drill pointed east towards foot wall.

Only one shaft is worked, No. 2, which is down 500 feet deep, and they are in the same lense of ore in which they worked in the previous levels. It is about 100 ft. long and 10 ft. wide. They are stoping in it southwest. They have some very fine black ore. I saw an analysis of a sample from this mine the other day, March 7, 1889—iron, 70.48 per cent; phosphorus, .064 per cent; sulphur, .021 per cent.

The mine produced in 1888 11,656 tons and will yield about the same amount in 1889.

The mine is owned by the Washington Iron Co. and held on a lease by the Humboldt Co.

J. B. Maas, Agent; Ed. Maas, Superintendent, Humboldt, Mich; G. A. Garretson, Sec. and Treas., Cleveland, Ohio.

The Humboldt mine, including its predecessor, the old Washington, has produced annually as follows:

Year.	Tons.	Year.	Tons.
1865	4,782	1877	16,546
1866	15,150	1878	23,921
1867	25,440	1879	18,204
1868	37,757	1880	14,727
1869	58,462	1881	26,302
1870	79,712	1882	43,436
1871	48,725	1883	31,866
1872	38,841	1884	23,763
1873	38,014	1885	11,776
1874	27,890	1886	20,207
1875	9,642	1887	17,874
1876	3,333	1888	11,656
Total			656,075

THE SAMPSON MINE,

lately the Argyle, and previously, for many years, known as the Edwards, is working again in a limited exploratory way. The mine was pretty thoroughly exhausted before it was shut down in 1884, so that last season when the water was pumped out of it not much ore was to be had; even the pillars were gone.

There are seams of ore, small lenses and pockets of ore in the foot wall rock, but so far it is found in too limited body to be of any practical value. It costs more to get it than it is worth. There is too much jasper and too little clean ore.

I visited the mine a few days ago—Feb. 10—and found a force of 18 men employed, getting a little ore in the foot wall of the old mine, and in the Sellwood shaft, etc. Mr. Richard A. Parker, the agent, is directing exploratory work with the diamond drill with what he deems encouraging results. The mine is the S. E. $\frac{1}{4}$ S. W. $\frac{1}{4}$ Sec. 2, and S. W. $\frac{1}{4}$ S. E. $\frac{1}{4}$ Sec. 2, T. 47, R. 29, and the company owns the land in fee simple. The formation runs slightly northeast and southwest, and the mine is near the south line in the jaspery hillside that slopes to the northwest, in which latter direction lies a long stretch of level land that has not been explored in.

Until more ore is found than is now known of on the property, the mine cannot be a paying one. Recently a building has been erected at the mine near the railroad track for the purpose of testing a process of separating the ore from rock. That is, the jasper, which holds about 30% of ore, is crushed

and ground, and the ore separated by a magnet-electro machine. Thus far the work is simply experimental, and is carried on by Mr. Edison, the inventor. Mr. Mallory, the superintendent of the work, showed me the analyses of the ore resulting from the manipulating process. It is first-class Bessemer ore; the phosphorus seems to be contained in the rock, since analyses of the material before treatment and of the ore afterward show that the phosphorus goes with the residue, rejected.

The officers of the Argyle are Morris Sellers, President, J. M. Sellers, Secretary and Treasurer, Chicago, Ill.; Richard A. Parker, Agent. The Sampson company was organized under the laws of Michigan in March, 1888.

The product in 1888 was 4,512 tons, making an aggregate to date, since 1886, of 260,456 tons of ore.

THE SAGINAW MINE,

which has been abandoned since 1883, is now held on an option by parties who are exploring it. I do not know that anything valuable has been found.

The location is the N. W. ¼ N. E. ¼ of Sec. 19, T. 47, R. 27. The mine has produced 439,328 tons of ore.

Adjoining it are

THE GOODRICH AND THE ALBION.

The former is in the W. ½ N. W. ¼, Sec. 19, T. 47, R. 27, and the Albion next to the latter. These are also being explored by C. R. Ely, Jos. Ames, P. Lundquist, *et al.* These abandoned mines are about three miles southwest from Ishpeming. The Goodrich has yielded 51,479 tons of ore, and the Albion 1,348 tons.

REPUBLIC IRON CO.

The most noticeable change at the Republic, recently, is the new compressor plant which has been lately added. The building is of brick and placed just west of the new office. The machinery consists of a duplex Rand with steam cylinders 48″x24″. The advantages are very apparent in the increased effectiveness of the drills; formerly they worked on about 35 pounds of steam; now they have 60 pounds. Heretofore all the compressors were at the dam in the river and the power was only sufficient with the size of the air cylinders to secure, much of the time, 35 pounds pressure. This, in such hard jasper as the Republic rock, is a very ineffective force. The compressors at the river are still used, but they have secured 60 pounds pressure in them by bushing the cylinders so as to reduce their interior dimensions. The same number of drills are used as formerly, but their

capacity is so greatly increased that it costs much less to accomplish drill work than formerly, there being a reduction of at least one-third in the cost due to the increase of air pressure. In fact Capt. Pascoe says that drifts that now are let for $18 per foot, cost, before the new compressors were in, $32 to $35 per foot. And there is a corresponding reduction in the cost per ton for stoping the ore.

The Republic mine is in a hard jasper formation and there is a great deal of rock broken that goes into the waste piles. The mine is peculiar in the fact that it is made up of a lot of independent lenses of ore lying transverse with the formation. These lenses in the west part of the mine are comparatively small and nothing but the superior quality of the ore has saved it from costing more than it sold for.

The Morgan, the most westerly pit, has fallen off in production slightly, and from present appearances will continue to do so. At present there is no magnetic ore in sight. The shaft has been sunk 60 feet and the usual amount of opening work has been done. The product for 1888 was as follows: Magnetic, 4,376 tons; Kingston ore, 6,678; specular ore, 20,259; total product, 31,313 tons. Its depth is about 900 feet.

The Pascoe pit is thought to look better than it did a year ago, in the bottom; but during the past year they have stoped the pillars in the upper levels to considerable extent. The Pascoe has two lenses of ore, the west one of which is specular ore, and is about 30 feet long and 17 feet wide; while the east lense is magnetic, and is 18 feet long and 5 feet wide. The Pascoe has also been sunk 60 feet deeper. It is a complicated, irregular formation. The product in 1888 was as follows: Specular ore, 11,000 tons; magnetic ore, 2,456 tons; Kingston ore, 4,370 tons.

The estimated product for 1889, is considerably less than this amount, to wit, 11,500 tons.

The Ely pit was thought to be, not long ago, nearly exhausted, but by using the diamond drill a lense of ore was found towards the Gibson pit 22 feet long and 14 feet wide, which has been drifted to and sunk in 60 feet. The products of the several kinds of ore from this pit in 1888: Specular, 8,172; magnetic, 483; Kingston, 3,893; total, 12,548 tons. In 1889 the product will be about the same.

No. 1 pit is much improved; that is, a body of black ore has been found that is 40 feet long and 6 feet wide in the hanging wall side. This deposit has been opened into in three levels.

No. 1 shaft has been sunk 100 feet during the year, and a large amount of drifting and opening work has been done. The pit yielded in 1888:

Specular, 20,787 tons; magnetic, 1,251 tons; Kingston, 1,936; total, 23,974 tons. The product in 1889 will be considerably in excess of this.

Nos. 3 and 5 pits present no new features; the ore obtained from them is taken from the pillars. From this source the product in 1888 was 27,696 tons, and they will mine about the same amount in 1889.

No. 6 pit, it is expected, will yield as much as it did last year, but the third level does not appear to be, as far as opened, as good as were the two above. A misfortune was met with in this pit, not long ago, through the fall of the roof about the underground shaft house. It made a serious crush that delayed the work of hoisting for a month. Of course it is all secured now. The product for 1888 was: Specular, 41,702; magnetic, 8,211; Kingston, 2,348; total, 52,321 tons.

No. 7 pit shows the most important change of any part of the mine. The magnetic ore has narrowed and shortened; the jasper has cut it out so that there will not be above one-third of the usual product in this pit, but on the other hand there have been found two large lenses of specular ore, which underlie the magnetic. The top one of these two newly found deposits is 90 feet long and 9 feet wide; the lower one was not fully opened when I saw it, but seems to be larger than the other; certainly it is much wider, as they had gone in across it 28 feet, and had no foot wall as yet. Thus the specular ore will fully make up for the falling off in yield of the magnetic. The product in 1888 was: Specular, 8,612 tons; magnetic ore, 32,239, Kingston ore 1,166; total, 42,017.

No. 8 pit does not show much change. It will afford the same product as it did last year. The shaft has been sunk 60 feet: that is, the Shenol shaft has been sunk; it is 210 feet northwest of the main shaft and the two are connected by a horizontal tram track.

The ore in Nos. 6 and 7 is reached in the same way: that is, by using in each an inclined auxiliary shaft to bring the ore up from the stopes to the level of the bottom of the main shaft. This method was introduced to save the expense of sinking the main shafts through rock and cross-cutting to the ore. These underground shafts are operated by machinery in the old No. 5 engine house, using the old drums that were formerly employed to hoist in the main shafts.

The product of No. 8 in 1888 was as follows: Specular ore, 19,291 tons; Kingston, 3,121 tons; total, 22,412 tons. The yield in 1889 will be the same, about.

No. 9 is a small pit, having a lense 20 feet long by eight feet wide, yielding Kingston ore. The product of 1888 was 2,036 tons.

Capt Peter Pascoe has had entire charge of the mining work ever since

the mine first started and anyone interested in mining cannot but accord to him a good deal of credit. The mine is now and always has been in good shape.

Chas. Hickox, President, Cleveland, Ohio; W. D. Rees, Secretary and Treasurer, Cleveland, Ohio; George Wilson, Agent, Republic, Mich.; Peter Pascoe, Superintendent, Republic, Mich.

The product for each year has been as follows :

Year.	Tons.	Year.	Tons.
1872	11,625	1881	233,651
1873	105,435	1882	235,108
1874	122,639	1883	152,565
1875	114,726	1884	277,739
1876	120,045	1885	249,070
1877	165,836	1886	241,161
1878	176,221	1887	233,375
1879	135,131	1888	235,064
1880	235,385		
Total			3,019,266

THE WEST REPUBLIC MINE

has been abandoned. The pumps have been taken out and all work discontinued. There were shipped from the mine in 1888, 9,861 tons of ore, making a total to date of 131,986 tons. The mine joins the Republic on the west.

A. C. Saunders, Secretary and Treasurer, Cleveland, Ohio.

THE REPUBLIC REDUCTION CO.

has abandoned all attempts to manipulate the rock burrows of the Republic mine. They are now simply sorting the burrows, selecting out such of the material as will do to ship for ore. The only difference between it and the Republic ore is in the percentage of silica contained. The ore shipped is above 60 per cent in iron and is Bessemer. I am told it finds a ready sale for "fix." The product in 1888 was 20,846 tons.

D. H. Merritt, Secretary, Marquette, Mich.

THE RIVERSIDE IRON CO.

is a new organization to operate the mine found by J. O. St. Clair on the Michigamme river near Republic. The mine is situated on lots 1 and 2 in

section 35, town 47, range 30. The ore is black, magnetic, and 5,761 tons were mined and shipped in 1888.

The company was organized July 3, 1888.

Dennis McCarty, President, Ishpeming, Mich.

The company has 6,000 tons in stock now, and have made some important developments with the diamond drill that add to the value of the mine.

J. O. St. Clair, Superintendent, also Secretary and Treasurer.

THE WESTSIDE MINING CO.

is working across the river from the Riverside mine. Mr. A. Polderman and others are exploring at the old Standard mine and adjacent property with, as they state, good results. The ore which I have seen, however, contained too much rock to be first-class, especially as it is non-Bessemer.

A. Polderman, President. Capt. Harry Buddle has charge of the work.

NORTH REPUBLIC MINE,

situated in Sec. 19, T. 47, R. 30, is an exploration that does not show very encouragingly so far. A shaft has been sunk 125 feet deep, and three levels opened—at 60 feet, 115 feet and 125 feet depth respectively. A small extent of drifting has been done. There is a lense of ore about three feet in width. The work has been done under the direction of Mr. Terrance Moore, of Marquette. The parties interested are in Grand Rapids, Mich. Work has been suspended.

THE ATLANTIC MINING CO.

owns 5,000 acres of mineral lands on the Marquette range, mostly undeveloped. These lands once belonged to the Morgan Iron Co., and lie near Morgan, Negaunee and Champion. The North Champion, North Dalliba, Pascoe and Mesnard mines are on the property. It is now proposed to explore the lands carefully, grant options for iron, timber, etc., and encourage the development of the company's property.

The following are the officers: W. H. McCurdy, Pres., Cleveland, Ohio; Dan'l H. Ball, Vice Pres., Dan'l H. Merritt, Sec., M. H. Maynard, Treas., all of Marquette.

THE PITTSBURGH & LAKE SUPERIOR IRON CO.

has met with great good fortune by reason of the magnitude of its newly discovered ore deposit. As the mine is likely to enter upon a new era in its history, a somewhat extended description may not be out of place.

The Palmer mine, formerly known as the West End mine, is at the western extremity of the Cascade range, one of the earliest noted of the iron formations of the Lake Superior district.

The range is distinguished by a prominent outcrop or bluff of banded jasper that extends east from near the west line of section 31 for two miles and upwards, and which rests on the granite that appears to the south.

This broad belt of jasper holds so large a percentage of iron that in an earlier day it passed for ore and was mined as such, being designated as "flag ore," owing to the flag-like structure of the formation. The companies that were formed and worked in this jasper were the Cascade, the Emma, the Pittsburgh & Lake Superior, the Wilcox & Bagley, the Home, the Carr, the Gribbon, the Watson, the Howell Hoppock, the Grand Rapids, the New Mexican, the Laxey, the Wheat, the Richards, the Palmer, etc.

But the only ones mentioned that have ever obtained any considerable amount of merchantable ore, are the Wheat and the Palmer companies. The latter mine was opened in 1872, by the old Pittsburgh & Lake Superior Mining Co—the same parties that owned the Cliff and National Copper mines. Subsequently it became the property of the Palmer Iron Co., and more recently passed, by purchase, to the present owners, who succeeded to the franchises and corporate title of the older company of the same name.

The jasper belt, which continues its westerly trend across sections 28 and 32, and to near the north and south $\frac{1}{4}$ line of 31, makes an abrupt bend at this point, and extends north 1,000 feet, when it, apparently, again goes west; but as the bluff has disappeared, and as the rocks further west are covered with drift, the extension of the jasper cannot be readily traced, further than the fact that the overlying quartzite, having the uniform northerly dip, appears in the bluff opposite to the west.

At the Cascade range are found the salient geological features that characterize the best hard ore formations and for this reason it is a locality that has always been regarded as having great possibilities. This well defined jasper and the overlying quartzite are typical of our best hard ore mines. The early mining in the Cascade range was in the jasper, whereas at the Champion, etc., mines the ore occurs on the jasper with the quartzite for hanging wall and these are the conditions which exist at the West End mine and at the "New Find" further east.

The West End mine is just to the south of the line between sections 30 and 31 and near the north and south eighth line through the west half of the section. The mine was formerly worked open cut, but for some years past the ore has all been taken from away underground. The open cut runs north and south and the dip is to the east. There are five skip roads up the

side to the west, but the only one that is operated is at the north end, and here the mine is away under to the northeast and north; 600 feet away to the east and a little north a vertical shaft has been sunk to reach the same workings. This shaft is 300 feet deep and the lowest depth of the mine is 60 feet further down. They are only working in the north end of the mine and along east to the vertical shaft and working in a primitive way. With better facilities and greater effort no doubt a much greater product could be obtained at this mine. I went through the mine and carefully examined some fine stopes of ore. I judge there is ore enough in sight for a large product, but better working conditions are necessary.

In opening this article I spoke of the recent discoveries of ore that gave to the property entirely new and greatly improved prospects. This new "find" is designated as the Saw Mill shaft. It is about 1,800 feet east from the West End mine and 800 or 900 feet north from the jasper bluff. It is not far north from the company's old saw mill, hence the name.

The ore was found by diamond drill borings, of which this record was given to me: No. 1 hole passed through 70 feet drift, 136 feet quartzite, 21½ feet ore, into jasper; No. 2 hole, 370 feet west of No. 1, 40 feet drift, 162 feet quartzite, 19 feet ore; No. 3 hole, 400 feet west of No. 2, passed through 55 feet drift, 125 feet quartzite, 17½ ore; No. 4 hole, 400 feet west of No. 3, was bored at an angle of 50° south, and passed through 163 feet quartzite, 7′ 8″ ore; No. 5 hole is 410 feet north of Nos. 1 and 2 and passed through 40′ drift, 34 feet quartzite, 22 feet of soap rock and penetrated ore to a depth of 24′ 7″, when the bit was lost while still in ore.

It will be seen that these borings indicate very favorably and since a shaft has been sunk the inference has been verified. Two shafts were started, one, following No. 1 hole, was sunk 106 feet only; the other, following No. 2 boring, was sunk to the ore, 300 feet down, and is now used as a working shaft. They have opened in this ore 400 feet east and the same distance west and gone up to the south perhaps 50 feet. The ore is all clean. It lies between the jasper and the quartzite and may extend a long distance in all directions. I think there is, undoubtedly, a large body of it. It is opened a length of 800 feet, and a drill hole 400 feet still further west shows its continuance. It widens east and north. It is one of the belts of the fold that forms the synclinal of the valley. It lays pretty flat, dipping in the mine about 23° north, and is very regular. The ore breaks very easily. It is slate ore, not hard, and crossed by transverse planes of fracture that cause it to block out readily and break up easily into small fragments. But as yet they have only one shaft in which they run only a loose bucket. With two shafts, good machinery and skips, 200.000 tons annually could be

taken from this mine, and possibly it is capable of furnishing a still greater amount.

That the ore continues down to the north is proven by the boring—No. 5, 410′—north of shaft, where it is shown to have an increased width, and was found at 381 feet from surface.

The shaft is 6′ x 10′inside the timbers, and divided into two compartments, one for hoisting and one for pipes, etc.

The quality of the ore is good, but averages non-Bessemer. An average of seven analyses of samples collected by myself from the old mine gives 61.40 per cent metallic iron, .085 per cent phos., 3.80 per cent in silica, and .007 in sulphur.

An average of four analyses of samples which I collected in the Saw Mill mine gives: iron, 62.53 per cent; phos., .105 per cent; silica, 3.74 per cent; sulphur, .004 per cent.

A second lot of samples from the Saw Mill mine gave as an average of six analyses: iron, 63.68 per cent; phos., .084 per cent.

The Chicago & Northwestern, and the Duluth, South Shore & Atlantic R. R. Cos. have both branches to the mine, and the brook that courses through the land south of the old saw mill will furnish water for steam purposes. There are a large number of miners' dwellings on the property, and a fine $25,000 agent's house, etc.

The company owns a large estate, and since I saw the mine it is reported that a portion of it—1,840 acres— which includes the mine, has been transferred to a new corporation, to be known as the Volunteer Iron Co.; the mine to be under the supervision of Capt. Thomas Walters, Supt.; James Broad, Mining Capt.; A. Kidder, Agent.

Year.	Tons.	Year.	Tons.
1871	4,171	1880	38,595
1872	34,495	1881	34,273
1873	41,204	1882	40,590
1874	16,106	1883	19,414
1875	4,070	1884	11,747
1876	15,324	1885	5,679
1877	20,211	1886	24,034
1878	4,704	1887	47,454
1879	24,141	1888	56,321
Total			452,536

THE WHEAT MINE,

which is situated in the Cascade range, east of the Palmer, continues to be operated in a small way. The ore is soft hematite of good quality when it is clean. In portions of the mine the ore requires careful sorting to keep out the rock. When clean it averages 63 per cent iron and .040 per cent phos. The following is the table of production:

Year.	Tons.	Year.	Tons.
1879	850	1884	6,824
1880	3,324	1885	9,200
1881	9,040	1886	15,851
1882	9,554	1887	17,537
1883	6,625	1888	4,982
Total			87,008

Capt. Thomas Prout, Supt., etc., Palmer, Mich.

THE SWANZY MINE

was not operated the past season. The aggregate production to date, which includes also the Cheshire, is 154,942 tons. I am informed that work will be resumed in 1889. Capt. J. S. Wood will take charge of it.

The location is the S. W. ¼ N. E. ¼ Sec. 18, T. 45, R. 25.

J. J. Pierce, Manager, etc., Sharpsville, Pa.

THE BRAASTED MINES,

which were formerly known as the Winthrop and Mitchell mines, and had been operated for a number of years past by the St. Clair Bros., under the corporate title of the Winthrop Hematite Co., but are now held and operated by Mr. F. Braasted, of Ishpeming, Mich.

These mines are contiguous properties and are situated about two and one-half miles southwest of Ishpeming. They are both among the oldest of the soft ore mines of the State and the Winthrop especially, has always been considered as a good property. The ore is of good quality, 60 to 64 per cent in metallic iron, and, though not Bessemer, the percentage of phosphorus is not far above the limit.

Under the superintendency of Capt. W. J. Officer, formerly of the Detroit mine, there has been great improvement at the Winthrop. The

engine house, which stood on the center of the section, has been moved to the south side of the large open pit. The cumbersome, unwieldy pumping machinery has been done away with, and a new steam pump—compound Worthington—now takes care of all the water. A new skip track has been made up the foot wall, south side of the open pit, and the large vertical shaft that was begun some years ago and sunk 225 feet, has been continued down to 400 feet in depth. They have repaired the old boilers and added new ones to give the mine plenty of steam power; and three new drums have been provided so that they now have six all in the one building; Merritt drums, each five feet diameter, and will suffice for both mines.

The bottom of the open pit is 205 feet below the surface and the former company worked down to the 280-foot level east to the Mitchell. The bottom level is now the 330 foot, and they have opened west from the downright shaft 400 feet, in six levels, all in ore, 40 feet apart, one above the other, so that the upper level is within 90 feet of the surface. The ore is 40 feet wide and a drift south in the mine has cut still another body lying back in the foot wall. East of the shaft the ore extends 300 feet to the Mitchell line, giving a total length of ore opened up of 800 feet or more.

They are driving west to intersect an old shaft, sunk some years ago, to a depth of 135 feet.

East of the downright shaft is the great open pit; west of it the surface is intact. They are mining now (February) 2,000 tons of ore per day and expect to ship during 1889 upwards of 100,000 tons from the Winthrop side.

They work out the ore in rooms 16 feet wide across from foot wall to hanging, timbering the open space with "sets," posts and caps eight feet long. All the work is proceeding systematically.

The ore from below the bottom of open pit and east is hoisted up the skip road, No. 4, and run out to a stock pile south. The ore from the new openings on the west goes up the vertical shaft and is stocked north of it. As the foot wall is soap rock there is probably ore to the south of the present opening. In fact they are sinking an old shaft begun years ago, which is a few hundred feet south of No. 4 skip road. South of the present engine house it is now (February) 35 feet deep. They are working about 225 men. Capt. Officer states that the total cost of all the improvements and new opening work will not exceed the previous estimates.

Altogether the mine is looking extremely well, but it is rather an expensive mine to work, and the ore being non-Bessemer will not sell at a fancy price. The profit after all costs are paid, including royalty on ore, will not be large.

Nothing has been done at the Mitchell by the new proprietors, but preparations are making to pump it out with the purpose of working it.

The Mitchell mine has produced annually as follows:

Year.	Tons.	Year.	Tons.
1872	197	1881	20,964
1873	8,552	1882	33,394
1874	7,699	1883	
1875		1884	29,883
1876	5,596	1885	7,415
1877	3,897	1886	42,044
1878	4,259	1887	53,592
1879	11,450	1888	36,396
1880	12,750		
Total			278,094

The ore is non-Bessemer, but close to the limit.

The annual product of the Winthrop has been as follows:

Year.	Tons.	Year.	Tons.
1870	2,469	1880	45,247
1871	7,314	1881	43,900
1872	14,239	1882	23,259
1873	31,150	1883	50,143
1874	8,248	1884	53,077
1875	8,642	1885	63,915
1876	27,236	1886	44,274
1877	12,549	1887	44,486
1878	23,740	1888	52,240
1879	27,050		
Total			584,063

THE SALISBURY MINE

holds the even tenor of its way, and is neither worse nor better than it has been for years, although it is furnishing more ore than formerly, probably due to increased effort. The main lense of ore is getting further and further south each year, requiring a further extension of the crooked shaft each year to reach it. To obviate this difficulty the long talked of downright shaft has been finally begun and is now 100 feet down. Its location is 600 feet

south of the present shaft, and the bottom level is now about midway between them. This new shaft is 9′ x 20′, outside measurement, and will be 500 feet deep to reach the ore. The mine has both Bessemer and non-Bessemer ore, about equal quantities of each; the deposits being parallel east and west and separated by rock. The ore is irregular and there is rock enough for pillars to support the roof, so that not much timber is required. They expect to have the new shaft completed during the present year—1889.

Considerable ore is yet obtained beneath the old open pit to the north, adjacent to the steep diorite bluff, but there is nothing of added value.

The Salisbury is in the city of Ishpeming, just south of the steep diorite ridge that borders the south side of Lake Angeline. It is the property of and is operated by the Iron Cliff Co.

Alex. Maitland, Gen'l Manager; Thomas Buzzo, Supt. and Mining Capt.

The following table shows the yearly product:

Year.	Tons.	Year.	Tons.
1872	545	1881	41,888
1873	11,023	1882	42,019
1874	6,730	1883	17,028
1875	4,571	1884	23,171
1876	20,510	1885	29,503
1877	37,868	1886	51,231
1878	52,155	1887	49,229
1879	39,770	1888	74,886
1880	22,387		
Total			527,849

THE HARTFORD MINE,

situated south of the east end of Teal lake, in the city of Negaunee, shows very little change for the better or worse. The holder of the lease of the lands, Mr. Ben Neely, has continued working in a moderate way, but nothing new or important has been developed. The shaft is sunk in the foot wall, and the ore is so far south of it that pretty expensive cross cutting is required to reach the ore.

There is an excellent hoisting plant at the mine, and a good engine house, etc., but not enough ore has yet been found to make a valuable mine.

THE CAMBRIA MINE,

in the Teal lake range, being south of Teal lake and about one mile from the city of Negaunee, continues to keep up the magnitude and reputation of its product. The mine is now, all of it, away north from the former workings. Years ago the mine was in deposits of ore that began at the west line of the property and extended in succession to the east boundary; but these are all worked out. They held excellent ore but became exhausted, and now the mine is north of all these—in about the center of the land east and west and nearer the margin of the lake. There is plenty of ore in sight to make as large a product as last year; in fact they expect to ship in 1889 80,000 tons, and have already (March 1) 19,000 tons in stock.

There are two shafts, designated as 2 and 3; the former is southeast of the latter, near the highway, and just east of the engine house; it is 350 feet deep vertically down. No. 3 is 400 feet northwest from the former and is 300 feet deep. This latter furnishes the greater portion of the ore. The ore extends north of this shaft 200 feet, and there is ore between the shafts and east of No. 2. The deposits are very irregular; they constitute pockets of ore in a mixed formation. They work out and others are found. Sometimes, in places, the ore is wide and again it narrows or cuts out altogether. A few years ago they had a large "cave" in the mine: that is, the ground sunk down and filled the mine, all of it, north of No. 2 shaft. The ore was very soft and the pillars would not hold up. Since then they have worked out two levels under this crush and have the bottom still all ore. The ore now is somewhat higher in phosphorus than it was in the pits further south. The percentage of iron remains the same, and it is still sold as Bessemer ore. The mine is excellently well worked and proves to be profitable. Mr. Maitland, who has always been the manager, is scarcely surpassed in that capacity, and the superintendent, J. B. Jeffrey, is a man of unusual intelligence and has had long experience as a practical miner. He gives close attention to the work and achieves the best results. Everything indicates it about the mine and in the condition of the mine underground. The force employed is 135 men. The mine is now opened up well ahead.

Table Showing Yearly Product of the Cambria Mine.

Year.	Tons.	Year.	Tons.
1876	6,324	1883	47,508
1877	10,082	1884	59,740
1878	3,754	1885	50,796
1879	6,860	1886	59,406
1880	7,232	1887	41,138
1881	18,837	1888	59,009
1882	47,545		
Total			418,295

THE LILLIE MINE,

as is well known, joins the Cambria on the west, and for a played out affair, as it seemed to be when the present company took hold of it, a few years ago, it is an exceedingly productive mine. Apparently no mistakes have been made in renewing the work here. They have got to the ore, and have got into it in good shape.

The old mine consisted solely of open pits, where the ore had been taken out. The pits having become very deep, and the sides having caved in, burying the ore in the bottom, the new company sunk below all this accumulation of debris and drifted into the ore beneath, which it has since been mining out.

Also it sunk a vertical shaft south of the west pit, away from the influence of the unsettled ground; and in this shaft is found the main body of ore—off in the hanging, south of the old deposits. This shaft is 315 feet deep, 283 feet to bottom level. The length of the body of ore is about 150′ east and west, and 100 feet wide. The dip is to the southeast. The ore pockets here, as in all the mines in this range, are in a formation of schist and broken jasper—a ferruginous schist. When speaking of foot wall or hanging, these terms apply simply to the particular pocket or lense of ore under consideration. The hanging wall of one pocket may be the foot wall of another, and so on.

They timber the rooms in sets, in the usual manner; but in the north shaft, working under the old pit, they take the ore all out, letting the ground above settle down. To do this they drift to the extreme end furthest from the shaft, and stope towards it, cutting a horizontal section from top of the ore, and letting the ground down behind them as they advance.

It is a good mine, though of course not a large one. The ore is clean, above 60 per cent in iron, but slightly non-Bessemer. It is well opened up now, and will make as large a product in 1889 as it did the previous year. The south shaft is at the northeast corner of the ore body, and is in rock, but close to the ore. The company works sixty men.

Statement of Annual Product.

Year.	Tons.	Year.	Tons.
1875	144	1882	28,221
1876	6,801	1883	2,172
1877	10,127	1884	2,683
1878	8,586	1885	708
1879	21,681	1886	3,957
1880	18,347	1887	23,041
1881	16,718	1888	32,692
Total			178,240

Wm. H. Barnum, Pres.; A. Maitland, Gen'l Ag't; Charles Koch, Supt.

THE CLEVELAND HEMATITE

is the next mine west of the Lillie that is now operated. The surface at this mine also presents some immense cavities from which ore has been removed in times past. The mine is now and has been for eight years wholly underground. The system of mining practiced here has been adopted to a considerable extent at other mines in the State. It has been adhered to here ever since the mine went underground.

The shaft is in rock, sunk to a depth of 726 feet, vertical, and unfortunately the ore body, which is a long irregular chimney, has constantly inclined downward away from the shaft, so that the present bottom is 640 feet distant, making it necessary to drive this long cross-cut to reach it. Thus at each level it has required this additional expensive work to be performed, after the shaft was sunk, before the ore could be attacked. The method of mining here is sometimes designated as the Cleveland hematite system. It is very simple. In proceeding to stope a level to which the shaft has been sunk and the cross-cut run, they keep a winze open to the level above through which to let down timbers and sink one from the top of the ore to the bottom below, or make a raise in the ore near the end of the cross-cut to the level above. They open a drift around the ore or from the point nearest to the shaft on two sides and on top of the ore under the dirt, after which

they cut off a horizontal section of the ore by commencing at the extreme end and stoping off a portion, transversely, eight feet wide and eight feet high, working from each drift towards the center. Thus by a succession of stopes from the farthest end they advance towards the shaft. The ore is run down through the winze to the cross-cut below and thence is trammed out to the shaft. The timbers that are used are light so that they will crush down when the ore is removed. They are made to hold up just long enough to get out the ore while the opening to the shaft is kept all the while intact. The ore is thus mined from the top down and everything over it is "allowed to come." If it does not crush fast enough, a blast is put in to bring down the over burden. The cross-cut from the shaft to the ore at the 725-foot level has not been driven yet.

They are obtaining the ore now between the 500 and 625-foot levels, the ore being "milled" down to the 625-foot level, from whence it is hoisted.

A cross-cut is driving in the 625-foot level to the "west deposit" which will soon be intercepted and will give additional ore. The mine is producing at the rate of 40,000 tons for the year's product.

It is the same depth as the Lake Superior No. 2 mine, the two being the deepest in the Ishpeming basin.

THE DETROIT MINE

is the next one west of the Cleveland Hematite, and is the only one in the Teal Lake range that is not looking as well as a year ago. Unfortunately for the owners there is very little ore in sight at the Detroit. The old mine, which runs the whole length of the property east and west, has some ore yet in the bottom, in places, but as the mine has crushed in, it is not easy to get.

The body of ore away south of the shaft, 600 feet, that they had just opened into a year ago, did not prove as large as was anticipated, and is practically all worked out. Just now they have a small body of ore in south which they are hoping will turn out to be much larger.

Capt. Joseph Thomas, the new superintendent, has the reputation of being a good miner, and will undoubtedly do all in his power to develop a better state of things.

The mine has had a somewhat chequered history. This is not the first time that they have been greatly short of ore. The old mine: The one near the shaft is non-Bessemer ore; the south deposit is Bessemer. The shaft is 350 feet deep and the cross-cut south 500 feet to the ore. Extreme distance

south from the vertical axis of the shaft, 650 feet. The product in 1888 was 19,665 tons, and the mine has yielded in all, 121,956 tons of ore.

James McMillan, Pres., Detroit, Mich.

THE MILWAUKEE IRON CO.

has so nearly reached the termination of its lease of the mine situated away up in the hills in the south part of the city of Negaunee, that unless a renewal is made there is not likely to be much exploring done for additional ore.

As it stands now the company can see the limits of its ore. No. 9 pit, at the west end of the property, adjoining the Grand Rapids mine, contains all there is in sight, and in this pit they are to the bottom—in fact have little left except the pillars. Still they mined 60,000 tons last year, and will make an equal product, they say, the coming year, and even then will have ore for a product in 1890—the last season of the lease.

One lift was sunk in 1888, and several thousand dollars expended in exploring work, but nothing new was found. The mine is still worked on a lease, by the Carmichael Bros., who mine the ore for the company, by the ton and furnish everything. They are good miners and faithful men. The company once paid, I am informed, 85 cents per ton royalty on the ore. A subsequent change was effected in the lease, by which a reduction of the royalty was made, but still it is too high. The surface at the Milwaukee is all cut up with open pits, from which the ore has been mined. There are none of them very deep. The ore formation is loose jasper and "soap rock," between the steep diorite bluffs which are to the north and the south. It is not considered that the possibilities of the location have been exhausted.

The mine yielded, in 1888, 48,908 tons, and the aggregate of the yield of the mine is 296,880 tons.

A. Kidder, Marquette, Mich., Agent; Carmichael Bros., Miners of the ore, etc.

THE GRAND RAPIDS IRON CO.

operates the mine, which lies adjoining the Milwaukee on the west. Nothing important has been developed in the past year. The mine can probably furnish double the ore than has been taken from it in the given time, since they have the new shaft completed and now have two shafts to hoist in. The old shaft, which is vertical, is 217 feet deep while the new one on the north side is 240 feet long; but as it descends at an angle of 45° it does not reach so great a depth as does No. 1. This new shaft is a good one, sunk

all in rock, and is well timbered. It is operated with a skip. Cost $28 to $32 per foot to sink it. At a depth of 160 feet from the surface is an exploring drift made to the west 60 feet all in rock. The ore opened out is irregular but it has a length of 140 feet, varying in width from 18′ to 30′ and the bottom is ore. They have two rises that come to the surface, through one of which they run down the timbers used in the mine. In a portion of the mine they put in square "sets." They tried the experiment of running down dirt for filling, but have not continued to do so. Are well opened out for the ensuing year's work.

The chief owners are residents of Grand Rapids, Mich. L. H. Withey, President, Grand Rapids, Mich.; J. C. Holt, Secretary and Treasurer, Grand Rapids, Mich.; Henry Warner, Agent, Marquette, Mich.; William Pascoe, Mining Captain, Negaunee, Mich. Work 60 men. Product, 1888, 11,612 tons; total production of the mine, 19,145 tons.

THE ROLLING MILL MINE,

also in section 7, south of Negaunee, furnishes a small amount of ore each year, but is not much worked. The mine is chiefly owned by Mr. Luther Beecher, of Detroit, and his son, George L. Beecher, resides at the mine and superintends the work, etc. The mine has produced 228,873 tons of ore.

THE EAST JACKSON,

formerly the Pendill mine, has been idle for some years, but now the company has commenced repairing the machinery and will proceed, it is said, to pump out the water in the old mine and do some further exploring, possibly attempt to drift to the ore that was found with a diamond drill boring made a few years ago and described in a former report. The property is favorably situated adjoining the Jackson mine, in a strong ore formation, and thus has good possibilities for the occurrence of ore. The work will be in charge of Capt. J. F. Foley, of Negaunee, and the owners are residents of that city.

Wm. Condon, President; J. E. Scallon, Vice-President; W. B. Northrop, Secretary and Treasurer. Office at Hancock, Mich.

THE LUCY MINE

is another of the so-called south side mines and is one of the oldest and one of the best of them. It was formerly known as the McComber; and after the failure of that company the mine remained idle for a time until opera-

tions were begun two years ago by the present corporation. The hoisting is confined to two shafts, Nos. 3 and 4, from the former of which some Bessemer ore is obtained—about one-half the amount hoisted. These shafts are respectively 235 and 254 feet deep; they are 300 feet apart, No. 4 to the southeast of the other. In the bottom from this shaft they are working to the northeast beneath the old open pits that lie in that direction. They have a length of 100 feet of ore of varying width, all non-Bessemer. No. 3, the northwest shaft, has ore mostly in the direction of No. 5, but also west of it there is a line of pockets of ore quite irregular. All these hematites are irregular and uncertain in this formation and the methods of mining and plans must conform to conditions that cannot be always very clearly foreseen. There will be no difficulty in making as large a product in 1889 as was obtained the previous year.

The company met with the misfortune of the loss of its engine house by fire in January, 1888, but it was rebuilt and is now better than before.

The Lucy is one of the properties (held on lease) of Mr. W. H. Barnum, Lime Rock, Conn.

Mr. A. Maitland, of Negaunee, General Manager; James Lowe, Mining Captain.

Year.	Tons.	Year.	Tons.
1870	4,856	1880	31,028
1871	15,442	1881	28,230
1872	25,030	1882	40,390
1873	38.332	1883	14,676
1874	2,642	1884	
1875	10,357	1885	
1876	17,282	1886	
1877	19,691	1887	11,584
1878	30,180	1888	22,276
1879	28,962		
Total			341,478

The mine is in the N. W. cor. of Sec. 6, T. 47, R. 26, in the city of Negaunee. It is situated in the side hill that slopes somewhat steeply down to the north for a distance of upwards of a quarter of a mile.

THE QUEEN.

Going east from section 7, we come to the new hematite mines that have been found in the vicinity of Negaunee in the past few years and which have

given fortunes to a number of enterprising men in that city. Chief of these new mineral deposits just now, and the one most recently discovered, is the Queen, which is one of the largest "showings" of ore for the amount of development made, that is to be seen anywhere. The shaft is 140 feet deep and they have two levels—the upper one 100 feet from surface. They have opened a width of ore 200 feet, and length of 100 feet. There are several seams of soap rock, which separate the ore into different lenses, and this rock has an aggregate width of 20 feet, leaving 180 feet of ore. But I do not see that they have, necessarily, reached the limits of the ore, either north or south. Of course they have not yet gone the length of it. The three deposits crossed, separated by soap rock, are, respectively: north vein 60 feet, middle vein 80 feet, south vein 40 feet. In the upper level analysis of these deposits gave for north vein, iron, 63.01 per cent; phos., .274 per cent. In the bottom level an analysis of the same deposit gave, iron, 64.93 per cent; phos., .078 per cent. In upper level analysis of south vein, gave, iron 63.14, phos. .174.

Other analyses of same gave, for north vein, iron, 63.07 per cent; phos., .047 per cent; iron, 65.06 per cent; phos., .046 per cent.

Of the blue ore—south vein—analysis by same chemist gave, iron, 61.23; phos., .098.

These latter samples were taken in the bottom level, and indicate a great improvement in the ore. The north ore is soft and contains a good deal of magnesia. The south lense is hard blue hematite. The formation, including the ore, has the appearance of schist, being a flag or schistose structure. It has all the appearance of having been a ferruginous schist transformed into ore.

The land is owned by the estate of Ed. Breitung and W. P. Ely, and is held on a lease of 40 cents per ton royalty by the Queen Mining Co.

Edward Lobb, Pres. and Gen'l Manager; S. P. Kline, Sec. and Treas., Negaunee, Mich.

The estate consists of the east 35 acres of the S. E. $\frac{1}{4}$, S. W. $\frac{1}{4}$ of Sec. 5, T. 47, R. 26. Company organized Jan. 31, 1888. Articles filed Feb. 20, 1888.

The ore is very clean—that is, no rock in it.

The fortunate owners of this lease will realize a handsome fortune doubtless. The shaft is vertical with skip, and is near the northeast corner of the 40. About 50 feet from it the dip is north.

It was formerly called the Swan.

THE PRINCE OF WALES MINING CO.

is the corporate name given to a newly-organized Co. holding the N. E. ¼, S. E. ¼ Sec. 5, a 40 acre parcel which joins the Queen on the north, and held on a lease by the company. The body of ore found in the Queen, no doubt extends into the land north of it.

The officers are, Ed. C. Anthony, Pres.; John F. Mack, Vice-Pres.; Sidney P. Kline, Sec. and Treas; Ed. Lobb, Supt., all of Negaunee, Mich.

THE SOUTH BUFFALO MINE

is in the S. W. ¼, S. E. ¼ of Sec. 5, thus placing it directly east from the Queen, which it joins. In fact the shafts are very near together, and underground the Queen people have in one place worked up to the line, so that the same bodies of ore, to some extent, lie in both properties. The South Buffalo, as well as the Queen, has a large amount of ore in sight. The main advantage that the Queen has is the fact that it seems to have some ore of a better quality than any of the others joining it. Apparently the South Buffalo could be so worked as to produce a great amount of ore. Not very much has been done since I last saw the mine, a year ago; it is no deeper, but they have drifted further, and one can see now what then he could only infer. The first level is 90 feet below surface—80 feet of distance through rock. Second level is 160 feet. They have opened east from the shaft, in bottom, 400 feet, two sets wide, and in the first level have raised up three to four sets high. They have a great width of ore as well as length; have gone west 160 feet, to the Queen line, making 560 feet in length opened, and more than 200 feet north and south in one place. On east have not crossed the ore only at the shaft.

No. 2 shaft, begun a year ago, is to the ore. The ground is low and wet. The exploring—of which there was considerable—heretofore done was in the hill south, and only lean ore found. When they came down into the swamp among the alder bushes the ore was discovered.

An analysis recently made of this ore by Mr. Uddenberg, of Marquette, gave, for two samples furnished him: Iron, 63 98 %; phos., .086 %; iron, 63.88 %, phos., .076 %.

The force employed now is about 40 men.

Peter Ranquist, Mining Capt.; Wm. Anderson, Pres.; Chas. Sudbury, Sec. and Treas., Negaunee, Mich.

Product 1887, 4,914 tons; product 1888, 24,707 tons.

THE BUFFALO MINE,

being in the N. W. ¼ S. E. ¼ Sec. 5, makes the fourth of the mines which corner at the middle of the north and south center line through the south half of Sec. 5. The Buffalo is the first one discovered and its success gave the stimulus to all the subsequent exploration that has led to such excellent results. There are four mines cornering at this 40 post and two of them have shafts near the common corner and the Buffalo is sinking another, so that soon there will be three of them all working within a stone's throw of one another and operated by different companies. The purpose of the Buffalo people is, of course, to get into the ore which has been found just south of their land and which, probably, extends into their own territory. The new shaft is 80 feet from the south line, 250 feet from the west line and 400 feet southwesterly from No. 2 shaft. The Prince of Wales joins on the west, the South Buffalo on the south and the Queen "corners" at the southwest.

When the new shaft is completed the company will have three. No. 1, the most easterly one, is 135 feet deep and from present indications will not be sunk further. They are boring with a diamond drill to prove the ground at the east end at greater depth, and if no more ore is found I understand that they will mine out the pillars at No. 1, which will yield about 5,000 tons of ore. They are now sinking No. 2 and the new shaft and are mining about 130 tons of ore per day. The body of ore at No. 2 continues to be about of the same magnitude as heretofore and will yield as large a product as last year. The best outlook for the mine is the anticipated results at the new shaft. The ore in the South Buffalo—Anderson as the mine is locally called—dips to the northwest towards the Buffalo and will, undoubtedly, be found north of the line. These mines are so near together that the deepest one will have to take the drainage of the others. The Buffalo shipped last year 30,801 tons, sold, mostly, to the Fond du Lac Furnace Co. It is soft hematite, 60 per cent iron, and non-Bessemer; when royalty is paid there can only be a small profit to accrue.

The mine has yielded as follows:

1886	10,860 tons.
1887	24,686 tons.
1888	30,801 tons.

The officers are John Paulson, President, Minn.; C. A. Avery, Secretary, Milwaukee, Wis.; Charles McGregor, Superintendent, Negaunee, Mich.

THE BLUE, LUCKY STAR, GEORGE MITCHELL, DELAWARE AND LACKAWANNA,

which are contiguous mines, all in section 5, are idle, nothing very valuable having been developed.

THE NEGAUNEE MINE,

which is also in Sec. 5, N. W. ¼ T. 47, R. 26, is a very interesting and valuable one. Interesting from the manner of occurrence of the ore, its peculiar structure, the way in which the ore is mined, etc., and valuable from the fact that the ore is rich in iron and sufficiently low in phosphorus to be Bessemer.

The mine has but one shaft, which is vertical and operated with a cage, and is now to the foot wall rock, having been sunk 16 feet the last year, making the total depth 438 feet; 12′x12′ inside timbers part of the way down, rest of the way, 10′x10′. The ore lies in a flat bed dipping towards the shaft from the south at an angle of 24°. The mining so far is all above the shaft to the south where they have drifted and roomed out to the boundary of rock on the three sides. A year ago it was thought that the ore might continue on up south to the sand and it was contemplated to start a winze from the surface at the point where the ore might be expected to come up; but the work has demonstrated the fact that the ore only continues up south about 400 feet, where it abruptly and completely terminates at a wall of rock. It does not wedge out gradually as is generally the case, but preserves its full thickness up to the rocky boundary which limits it. Thus we have here a low lying lense or deposit of ore the top of which is 260 feet below the surface. The deposit has a depth of ore between the walls of 15 feet to 35 feet and a width east and west of 350 feet and length up the foot wall of 400 feet. No opening work has yet been done to the north, below the shaft, though the ore continues all right in that direction.

The ore is a flag or schist structure, precisely the appearance of a wall of thinly bedded flag stone—a ferruginous schist that has been changed into ore.

At the south end of the deposit and along the east wall the ore is hard and compact, differing materially in appearance but affording the same results on analysis. The cut-off of the ore is caused by the foot wall turning squarely up and connecting with the hanging. In mining they have cut out rooms extending from the main level up south, leaving pillars of ore between; no timbers are required, the hanging wall being naturally firm

and secure; both walls are well defined. The rooms are numbered from the east side, there being seven in all, though 1 and 2, further up, are one and the same. In 1 and 7 they mine diagonally up to the side walls. To get down the ore to the main drift they employ a succession of chutes with short trams between: that is, they make a chute which starts on the foot wall, the upper end being gradually raised as the stoping proceeds, until finally, at a length of 60 feet, it is near the hanging. From the top of this chute a horizontal tram road is laid through the ore to the foot wall side into which an opening is cut sufficiently capacious to admit a car to stand under the end of the next rising chute. Three of these chutes, one after the other, suffice to reach to the end south. They back stope the ore, mainly, to the hanging, standing on the broken ore—"dirt"—that is left to lie on the foot, so that scaffolding is not necessary. Now, where the rooms are done with, they are beginning to cut the pillars, also working from the south end down and will let the roof fall behind them; thus all the ore will be obtained. The mine, naturally, is very dry, since all the water easily finds its way to the sump at the foot of the shaft, where it is thrown to the surface by a large steam pump.

How they will mine the ore below, going north from the shaft, I do not know; no work has been done in it as yet. They might make an inclined shaft in the foot wall and pursue the same method as now—running the ore down to a main level below and hoisting it up the inclined to the vertical shaft. Though having but a single shaft there is an abundance of air. It seemed to me to be as well ventilated as a mine need be.

In 1889 the mine ought to be profitable. By taking the pillars on the south side they will get a product that will be cheaply mined.

Product 1887, 5,359 tons; 1888, 45,304 tons.

Capt. Samuel Mitchell, Agent, etc.; Capt. Albert Newcome, Supt.

THE MENOMINEE RANGE

lies about 50 miles south of what is designated as the upper or Marquette range. It extends from town 39, in range 28, Michigan, northwesterly along the border of Mich. and Wis., to about township 41, range 34.

It is bounded on the south by the Huronian granite, which is readily traced south of the Menominee river for the whole distance, where indications of the iron-bearing rocks have been observed. The eastern portion of the range is limited on the north by the Laurentian rocks, which may be found as far west as range 31. North of the Laurentian and west, are the Huronian rocks, connecting the Marquette and Menominee ranges.

The Menominee range is understood to mean the series of mines along the boundary between Mich. and Wis., adjacent to the Menominee and Brule rivers. In the list are many good mines; some of the largest and most valuable deposits of ore in either Michigan or Wisconsin, are found in the Menominee range. All the ore in the Menominee district is so called hematite or soft ore. No magnetic or specular hard ores have been discovered.

No longer ago than 1872, this whole region, now known as the Menominee range, was a dense wilderness, penetrated by neither railroad nor highway. In fact, up to 1873 it was not certainly known that good ore existed, in quantity, in this district. The country had been traversed considerably by explorers, much mineral land had been purchased from the government, outcrops of lean ore had been observed, but until '73, '74 no first-class ore had been found. From that time on, however, the district developed rapidly, and has since become one of the most prosperous sections of the entire country, having numerous mines, rich ores, prosperous cities and villages, two lines of railway, excellent highways and an intelligent, industrious population.

Commencing at the eastern extremity of the range, I will refer to the mines in their order of occurrence to the west.

AT THE BREEN MINE,

at Wauceda, exploration has been going on for nearly a year, but in talking with Capt. E. S. Roberts, a few days since—March 1—I find that no important success has been met with. Capt. Roberts has conducted the exploratory work. The location is the N. W. ¼, N. E. ¼ Sec. 22, T. 39, R. 28, and also the N. W. ¼ of same section.

THE EAST VULCAN MINE

has been the scene of much active opening work the past year. The plan of operations as described in my last report has been carried out. The new shaft that was for so long held under contemplation has been sunk. The long drifts connecting it with the old mine have been made; new machinery has been added, other shafts have been deepened, and although the total expenditure has been necessarily large, the work has been pushed so vigorously and with so much skill and economy that the cost is much less than it might have been. It has been the endeavor, since the new plans were determined on, to accomplish in the best manner, in shortest possible period of time and with the utmost economy.

It will be remembered that this new shaft is midway between No. 1 and No. 3 shafts, 800 feet from each, and it was sunk 660 feet deep in nine months' time, certainly a remarkable record. The size of the shaft is 16′ 1″x6′ inside of timbers, the shaft timbers are 12″x12″ and are in sets 4′ apart. It is, like all the other shafts at the East Vulcan, divided into three compartments, the dividers being 6″x12″. The two end compartments hold the cages and each is, in size, 4½′x6′, the middle compartment being 6′x6′ and used for the pipes, etc.

The work of sinking was begun in November, 1887. The first 40 feet of sinking was in sand when the ledge was struck and the sinking continued for the next 60 feet in sandstone, coming thence to red slate which held for an additional 118 feet, when hard, black jasper slate succeeded, in which the shaft was sunk a further 321 feet, and thence the remaining 121 feet was in red slate.

The minimum number of feet sunk in any one month was 65 feet and the maximum progress in any month was 107′ 10″ and the average number of feet sunk per month was 73′ 4″. In sinking the first 72 feet only a windlass was used, but subsequently two 12″x16″ Rochester hoisting engines were used, operating two 4′ drums.

The cage compartments were completed as fast as the shaft went down and the cages were operated in doing the sinking, the buckets being attached to the bottom of the cages are carried up with their filling of rock above the landing, by the ascending cage, and then made to rest upon a car that is run over the mouth of the shaft and under the buckets, whence the load is trammed out through the tunnel and dumped.

As described in a former report, the bucket is made to discharge automatically.

The cost of sinking the shaft was as follows:

Labor, sinking, handling and timbering	$10,993 67	or $16 65	per foot.
Labor, hoisting and pumping	1,437 74	" 2 18	"
Timber	3,834 17	" 5 81	"
Fuel, iron, steel, explosives, oil, etc.	10,690 97	" 16 20	"
Total cost of shaft completed	$26,957 15	or $40 84	per foot.

The average rate of sinking per day was 2 feet 10 inches, and the average rate of wages paid $1.683 per day.

The first 307 feet was sunk by hand drilling, then by two Rand slugger drills, until the last month of sinking, when three Rand slugger drills were used. The Rand slugger drills have proved to be the best drill ever used here, and all other drills have been abandoned.

The men employed to do this work were Italians, Swedes and Polacks.

This system of sinking has never been employed by any other mine in this part of the country, neither is there another shaft timbered after this pattern.

An engine house has been built at this shaft and two engines, respectively 12″ x 24″, and 14″ x 24″, and also two boilers and two 5′ drums provided.

Two long drifts have been made to connect the new shaft with old No. 1. They are in different ground, and together make 1,000 feet of drifting—425 feet of it, however, were driven in 1887.

The south vein drift is 425 feet below surface, while the other is at the bottom, 533 feet down and 125 feet south of shaft. This drifting cost, all told, $10 per foot. In addition a good deal of drifting was done in No. 1 in first level west and north, distances of 200 feet. They are driving east from the shaft in the 633-ft. level, to reach the ore in No. 1. At the time of my visit at the mine they had just struck in the cross-cut from the shaft in the line of the ore, a new body of ore, which they were following east and west from the cross-cut. It was about four feet wide and very rich ore, an analysis giving 69.62 per cent iron, and .026 per cent phos. Capt. Curnow was much elated at the occurrence of this ore, as it was wholly new and unexpected, and bid fair to become a fine addition to the ore deposit of this shaft. No. 1 deposit is a chimney of ore that went down nearly vertical at first and then inclined to the west at a very low angle until it had become a matter of great expense to reach it from the shaft. To get at this ore was the reason that determined the sinking of the new shaft. This shaft has been sunk upwards of 100 feet below the bottom of the mine, and they are now drifting east from the new shaft to reach the ore, and in doing this they unexpectedly encountered the vein of ore as explained above. This preparatory work has cost, probably, $50,000.

The No. 3 shaft produced finely last year 24,000 tons, and it was cheaply obtained. No. 3 shaft ore has cost the least of any at the East Vulcan. A year ago they opened into a large deposit that has been nearly worked out and the bottom of it is rock. Just now it does not appear that the shaft will yield as well as it did last year. The East Vulcan mine is a pockety concern; I think there has been more drifting done in it than in any other mine of its size in the State. If it were not the best of ore, if the company and its local management were less able and persevering, the mine would have been abandoned long ago; but now, if expectations are fulfilled, it will be more profitable.

The depth of No. 3 shaft is 450 feet. Among the improvements is a new shaft house and two new cages in the shaft; also have the plant of

machinery formerly used at the Quinnesec, two 5′ drums, W. C. & L. pattern. There are now in stock at No. 3 16,000 tons of ore.

No. 2 shaft is 350 feet deep vertically down; is also a two-cage shaft. A world of drifting was done but only 524 tons of ore obtained. Capt. Curnow thinks, however, that the mine will yield 10,000 tons in 1889. There is a chimney of ore 104 feet high and they have sunk a winze in it 70 feet, so that from this showing the estimate is made.

They have fine stock grounds now at all the shafts. The company has well earned all the success at the East Vulcan it is likely to get. It will be a matter of much satisfaction to have it turn out well.

Sec. 10, joining East Vulcan on the west, has been added to Capt. Curnow's dominions and he is conducting an exploration near the west line of the section in the side hill, in the line joining East and West Vulcan mines. Here he has sunk 75 feet in soap rock and cross-cutted south 30 feet in soap rock, 123 feet jasper. Also drifted west 50 feet, along the north soap rock, and east the same distance along south soap rock. The drift is mixed ore and rock.

The product of the East Vulcan, 1888, was 24,401 tons.

THE WEST VULCAN

seems hardly to be holding its own. The company has just completed its preparations for operating the mine at its increased depth and on the assumption that the deposit would retain its magnitude. When I went through the mine a year ago, it was looking finely; they were then opening the ninth level and it showed an increased length and no diminution in width. The ore averaged about 30 feet wide for a length of 300 feet and for the remaining 300 feet in length it averaged about 10 feet wide. But the 10th level, recently opened, shows a quite different appearance. The ore is not above 18 feet wide in the widest place and narrows down each way to three or four feet. Besides this, the ore is mixed with limestone so that some of it is worthless. The downright shaft is sunk to the 11th level, 855 feet deep. They have been pursuing the new plan of mining: that is, taking out all the ore and substituting rock, etc., in its place. To accomplish this a drift in the foot wall in each level from the sixth down has been made and the ore has been attacked through cross-cuts from these main drifts and the ore has been cut out in sections across the deposit, rising up by successive stages from the ninth to the eighth level. In the 10th the foot wall drift was started but discontinued when it was found that the ore had diminished so greatly.

There is about 30 feet in height of ore standing in the ninth level, between it and the eighth. Also there are four pillars of ore in the eighth level. The ground is opened from the 10th to the 9th; winzes all sunk for running down the rock for filling.

At No. 2 shaft they had cut out the pillar in the eighth level and had timbered it well, ready to fill up with rock; but the ground suddenly crushed in from the seventh level down to the ninth, making a troublesome job to restore the shaft. It has been done, however, and No. 2 shaft is better than ever. It is in the foot wall 375 feet east from the downright and is a double skip shaft. The mine is in admirable shape in every particular, except in the contraction of the ore deposit, and the limestone occurring along the foot in the bottom. The ore has thus become poorer in quality and less in quantity.

It will be seen that the new shaft has been sunk 200 feet and No. 2 100 feet in the past year, besides the work of reopening the 200 feet of No. 2 that caved in.

There are about 30,000 tons in stock, and the product for the year 1888 was 94,958 tons.

THE CENTRAL VULCAN,

so called, because it lies between the East and West Vulcan, is about exhausted. There are 3,000 tons of ore in stock and 9,411 tons were shipped from the mine in 1888.

THE CURRY MINE,

which joins the West Vulcan on the west and which came into the possession of the Penn Iron Co. about a year and a half ago, is proving to be a promising property. It yields the best ore the company has. They are working in several places, some of them old pits and some new discoveries, but the best one is the shaft at the foot of the hill close to the highway, which I mentioned in my last report, and which is proving valuable. A recent analysis of this ore gave 63% in iron, .006% phosphorus.

The old Curry shaft has been freed of water, and they are now—March—hoisting 40 tons of ore per day from it. The shaft is 238 feet deep and the drift west to the breast of ore is 358 feet. This stope is 18 feet wide and 50 feet high. It is contemplated to sink a shaft to the west, near the west line of the property, since the ore, probably, goes into the Briar Hill lands, held also by the Penn Co. The company secured with the lease of the mine a good plant of machinery—2 Lowe drums, 4′ diam., etc.

Further up on the hill and to the east is an old pit, on the east of which the company has found a flat deposit of ore, which will yield 5,000 to 10,000 tons. It lies on jasper and has slate covering. It is 200 feet above the lake that lies 350 feet south beyond the railroad. It will be some trouble to get this ore to the cars. Some sort of an incline will be resorted to, no doubt.

The Curry will yield 25,000 tons in 1889—that is Mr. Hagey's estimate; and it is all rich Bessemer ore.

THE BRIAR HILL MINE

is also now one of the Penn Iron Co.'s properties. The company is simply exploring it. It does not produce any ore at present, but they have sunk a shaft just south of the highway and railroad 100 feet deep, and have drifted north in the bottom 60 feet, and are now drifting south; are about the same distance in mixed ore and rock. The prospect does not seem to be very good. I think that boring with a diamond drill across the formation, at greater depth, would be more satisfactory. Since the above was written the company has begun to sink a winze at the south end of the cross-cut, and finds much better looking rock.

THE NORWAY MINE

presents no new features, except that the outlook for future products has become somewhat more dubious. The good ore at this mine—"The Norway ore"—is nearly exhausted. There is a good deal of B. B. ore still in the mine, but not much, comparatively, of the other. Their plan now is to strip the mine in the extreme east and west ends, where it is all underground, and let the surface dirt run down into the openings, and then to mine out the pillars. The east end is completely honeycombed with drifts. There are many large rooms supported by pillars of ore, with wide stretches of roof between, that stand remarkably well. I scarcely know of a formation that is so self supporting as this. The ore is cut out by the underlay of limestone that dips in irregular folds to the south. In the wrinkles in the folds of this limestone the best ore has been found for several years past. The bottom is becoming pretty well cleaned up now. They are making three grades of ore now, to wit: Norway, B. B. and a mixture of the two latter grades, which I think is called B. ore. Norway goes 55 per cent iron, .040 per cent phos.; B. B. 60 per cent iron, .120 per cent phos.

The mine is 450 feet deep—400 feet to bottom level. Of the ore shipped in 1888, 75,000 tons were straight Norway. The mine has been very fully

described heretofore, and I find nothing new to add. It looks now as if there were little further to do at the Norway but to "scram the mine"—get out the pillars, etc., in the cheapest way.

The following analyses of the ores of the several mines of the Penn Iron Co. may be of interest.

Average of samples from the stock piles of Penn Iron Co., April 21, 1888:

Name of Mine.	Iron.	Phosphorus.
Nos. 3, 5, 8 and 9 stock piles, Norway mine	55 05	.069
New shaft stock piles, Norway mine	61.37	.097
Nos. 3, 5, 8, 9 and New Shaft together, Norway mine	55.73	.073
Vulcan stock piles	55.25	.042
Central stock piles	60.96	.075
East Vulcan stock piles	53.75	.043
Vulcan Central and East Vulcan together	55.67	.045
Cyclops stock piles	57.81	.019
Quinnesec stock piles	58.43	.016

The following is the amount of ore shipped from the Penn Co.'s mines in 1888:

Norway	87,164 tons.
Cyclops	14,662 "
West Vulcan	94,959 "
Curry	5,376 "
East Vulcan	24,401 "
Central Vulcan	9,472 "
Quinnesec	2,020 "
Total	238,054 tons.

The Quinnesec mine has been abandoned by the Penn Co., and no one is now exploring it. The total force employed by the Penn Co. in all its mines is 850 men. An important improvement which has been made in the last year is the pumping of water from the lake below the mine up into a reservoir on top of the hill above the West Vulcan mine. It supplies water for the boilers and a head of water to extinguish fires.

The Vulcan mines were opened in 1877, and have yielded as follows:

Year.	Tons.	Year.	Tons.
1877	4,543	1883	79,874
1878	31,239	1884	101,722
1879	57,350	1885	124,120
1880	72,405	1886	143,930
1881	85,671	1887	205,127
1882	94,042	1888	128,832
Total			1,128,805

The product of the Norway for each year is as follows:

Year.	Tons.	Year.	Tons.
1878	7,533	1884	71,515
1879	73,540	1885	57,741
1880	198,765	1886	93,878
1881	137,558	1887	95,558
1882	165,084	1888	87,164
1883	114,836		
Total			1,102,342

The officers are J. E. Hagey, General Manager, Penn Iron Co.; John Oliver, Superintendent Norway and West Vulcan; John U. Curnow, Superintendent East Vulcan.

THE CYCLOPS

is the only remaining mine of the Penn Co. to be mentioned; it is west of the Norway and is worked in connection with that property. They are mining in only one place and that is in a pit away up on the hill north of the west part of the village, where they had, in an open pit, a deposit of ore 6′ wide and 75 feet long.

THE PERKINS MINE,

which is also in the village of Norway and joining the Norway mine, is still worked, though its final abandonment cannot be long deferred. Undoubtedly Capt. Perkins finds it profitable, as he has no water to pump. The Norway being deeper drains the Perkins. The ore obtained in the Perkins

is mainly from the pillars that could not be got until the mine had caved in, as it has done.

The mine has produced in all 376,300 tons of ore.

John Perkins, Proprietor, Norway, Mich.

THE ARAGON MINING CO.

is the corporation that has been organized to develop the Smith-Butler property at Norway, Mich.

The property consists of four forties, in a row east and west, commencing at the Briar Hill and extending west one mile. It embraces the Norway town site, joining the Norway mine on the south, and consisting of the N. ½ of the N. ½ of Sec. 8, T. 39, R. 29.

A year ago when I described the property the association was engaged in endeavoring to sink a shaft near the west line of the N. E. ¼, N. E. ¼ of Sec. 8, but after repeated effort they failed to get to the ledge, and the attempt was abandoned, finally. The location is in a cedar swamp, originally very wet and of course, in such a situation, sinking to the ledge through sixty feet of quicksand and associated material, becomes a difficult matter. It may seem to be easy enough to the uninitiated, but observation, or a little actual experience, will soon develop to his satisfaction enough of perplexities to tax the greatest skill.

Per Larsson, mining engineer at the Chapin Mine, was placed in charge of the work at the Aragon, and has got matters in shape so that the shaft is sinking without any delay. At the time I was down—about March 20—it was 52 feet deep, thus there were 8 feet further to sink. Mr. Larsson started from the surface, in about the center of the forty, and has no less than eleven pumps at the other shaft; the purpose being to drain the ground by pumping the water from the other shaft and running it away to the west in a launder. He is sinking a water-tight timber shaft, 6′ x 14′ inside top dimensions, and 8′ 4″ x 17′ 4″ bottom area; thus the shaft will have a downward, outward batier of 1″ to 1′. The shaft is lowered by adding the timbers and also weighting it at the top and digging and excavating in the bottom and under the timbers.

The bottom timbers are oak and are beveled on the inside face so that the under edge is sharp. Sheet piling is kept driven all around the timbers at the bottom to prevent the influx of water and sand.

I witnessed the raising of one of these plank piles and the quicksand came in with a rush. The shaft is supposed to be in the foot wall of the ore. The discovery of the ore is explained in my last report, and there is nothing

to add in that respect, beyond the fact that Mr. Larsson has begun to explore further with the drill. There seem to be two lenses of ore. The main boring passed through jasper, slates, then 140 feet of ore and into jasper again. Further east was found, in a boring 9 ft. of ore, but north of the former, apparently separated from it by a large body of jasper and slates. They are exploring with the drill, the ground between these holes, east and west.

In the shaft now sinking, at a depth of 20 feet from the surface, the fossil remains of an animal were found. Only the skull and one tooth were saved. The remainder of the skeleton, if it existed still, was outside of the timbers and difficult to reach. It appears to be the skull of an elk, and was found just under the marl—first, 10 feet of muck, then marl.

They are adding a second boiler and inclosing it in with brick.

Considerable local interest attaches to this mine. The ore is shown to be, from analyses of the drill cores, of the best quality—65½ to 69 per cent in iron and .012 to .033 per cent in phosphorus. Its success is an important consideration to the people of Norway. Since writing the above, the shaft is now, April 15, two feet into the ledge which is slate. Still more recently, the ore has been reached in a cross-cut north.

Angus Smith, President, Milwaukee, Wis.; Per Larsson, Superintendent, etc., Norway, Mich.

HAGEY & PORTER MINE

represents the exploration making by Messrs. General Managers Hagey and Porter just south of the Aragon shaft. These gentlemen hold a lease of this land and have begun to explore it for ore. The situation is favorable for such an undertaking and I see no reason why they should not meet with success.

THE CHAPIN MINE.

Quite a sensation was awakened recently by the announcement that the Chapin Mining Co. had sold its franchise and interest in the mine to a foreign syndicate, through representatives in this country, for the sum of $2,000,000. However the report was the announcement of a fact; the sale has been made and there are other ultimate proprietors than formerly of the Chapin mine.

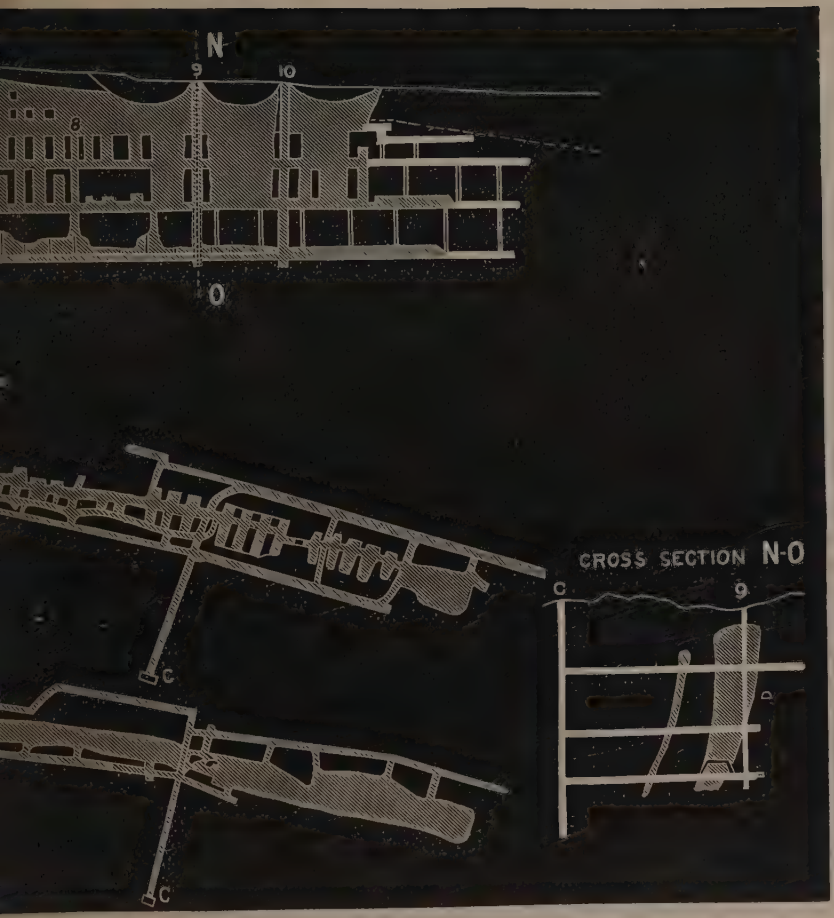
No difference is apparent at the mine; there is no change in the local management; everything goes on as heretofore and I hear of no likelihood of any interference, fortunately.

MAP OF THE

Scale : 3

PIN MINE, 1889.

o an inch.



It will be remembered that for a year and more past the Chapin company has been pursuing an entirely different system of mining than it had previously. They have been filling the mine, recently, as the ore was removed. The method by which this work was accomplished I have endeavored to explain in previous reports—'86–'87. But now, after a trial, the management has about decided to abandon the system thus inaugurated and to proceed upon a quite different plan.

The shafts—B and C—are on the hanging wall side of the ore; at first the attempt was made to drive tunnels in the hanging wall north of the ore and so to reach the ore from these drifts. But this was speedily found to be impracticable, as the drifts crushed in and could not be kept passable. Then a further modification was made by driving the main cross-cuts from the shafts through the ore into the foot wall and making the main longitudinal drifts in this rock, 40 feet and upwards south of the ore. These foot wall drifts are shown in the accompanying plans of the fifth and sixth levels. They are cut in the slate foot wall, seven or eight feet high and 9 or 10 feet wide, and I was greatly surprised the other day, on going through the mine, to find that this foot wall drift in the fifth level, as well as many of the cross-cuts leading from it to the ore, had crushed in; crushed down so as to make it difficult or impossible to get through them. They are now making a new tunnel in the fifth level, 100 feet and upwards, in portions from the ore; so that it will be seen that this drift and the cross-cuts to it from the ore, together with the "rises" in which to run the ore down into the cars, have all to be made anew. All this reëxpense must be incurred by reason of the non-stability of the foot wall.

But in truth, they are miserable walls anyway—a soft, friable, unstable slate, that crumbles and disintegrates on exposure, so that the walls even of a drift will not stand.

I have observed slips or seams of clay in the foot wall drift. Such rock can have little sustaining power. Thus far the foot wall drift in the 6th level remains intact, and all the ore mined out in the 5th level goes down to the 6th, and thence to the surface.

The endless rope system that runs in the 6th level, to and from C shaft, works admirably. The tramming is thus done by machinery. The handling of the cars at the shaft is accomplished with much celerity. The loaded cars go directly on to the cages from the front, while the empty cars are pushed off to the rear and around the shaft into the line of the track in which the wire rope is constantly running. There is no delay; the cars are hoisted very rapidly; the changes are quickly made.

It is rather pleasant to sit here in this dry, commodious shaft yard in the 6th level and observe the loaded cars constantly arriving and the empty ones going away, and to see how rapidly they are sent to the surface, discharged, and the cars returned and sent back to the stope for another load.

The unloading of the cars is something different from that seen anywhere else. The tram car, with its load as it comes up out of the mine, is run out over the trestle on an iron-frame, skeleton car, and everything so adjusted that when the place for the discharge is reached the car is made to revolve, casting out its contents and immediately returning to the shaft. The entire operation is performed quickly; no one goes out with the car.

The company has built a long trestle, nearly a third of a mile, from the shafts to the Milwaukee & Northern R. R. track, where they have made two ore pockets. There are two tracks operated with an endless rope. Last fall they run from the shafts to these pockets 80 cars in an hour—two tons to a car—160 tons of ore hoisted from the mine and run one-third of a mile and discharged in an hour. The cars are made to discharge at the pockets auto matically, the instant they arrive; go down on one track and back on the other. They pass right around without scarcely stopping, revolving and discharging as they go.

I stated previously that the company was about to greatly modify its system of mining. The plan under contemplation now is to abandon the foot wall drifts in the lower levels, and their present method of taking out all the ore, but to further sink the shafts to the 8th level, 200 feet below the 6th, and to open a longitudinal drift through the center of the main ore body, and from this to make "headings" or rooms each way from it to the foot and hanging 18 ft. wide, leaving pillars of ore of equal width, and to back stope the ore in these rooms to the full height of the level—that is up to the 7th, by successive rises or horizontal sections, and to fill up the space below, as fast as a rise is made; so that when the room is stoped out it will be filled with rock. No timber will be required, as it is known by former experience, before any filling was resorted to, that the roof for a space of 18 ft. will stand without support for a length of time necessary for mining out the ore. It is the intention to leave the 7th level—100 feet high—up to the 6th undisturbed. In this way it is thought that all movement of the ground will be avoided, and that the ore will be more cheaply obtained.

They are sinking a shaft in the foot wall about opposite the west end of the underground opening, 700 feet from C shaft. It is 200 feet from the ore in the foot. It is a five-compartment shaft and will be used for timber, rock and ore.

The sinking of D shaft in the low ground, 1,100 feet west of C and 600 feet east of the west line of the property, by the freezing process, has progressed rapidly until now, March 10, when, it is thought, through the fact that one of the pipes is not to the ledge, and the ground under it not being frozen, the water and quicksand is admitted beneath into the shaft and the work of sinking has come to a standstill.

The pipes, 27 in number, were driven in a circumference, the diameter of which is 29′ 6″. The shaft sunk in this circle is 24′x26′, to be a four-cage shaft. The excavation is accomplished by first freezing the ground, done by the Poetsch-Sooysmith freezing process. The original pipes are 10″ diameter, sunk 98 feet to the ledge. Within these are placed 8″ pipes, closed at lower end, and within the latter 2½″ extending to the bottom and through which the liquid is forced. All these interior pipes are connected in one system—the inflow of the freezing mixture—and the exterior 8″ pipes are all connected in one system—the return system of the fluid. In the temporary building adjacent to the shaft are a condensing engine, pump, and two large tanks, one containing cold water, the other liquid, chloride of calcium. The condensing engine forces liquid ammonia through a small pipe coil placed in the cold water tank: the purpose being that the latent heat generated by the condensation, is absorbed by the water. Thence the ammonia circulates through a similar coil, but of larger diameter of pipe; the sudden expansion securing a low degree of temperature by reason of which the cooling of the fluid, calcium chloride, through which it circulates, is effected. The temperature of the calcium chloride is thus reduced to 19° Fahr., in which state it is sent forward to circulate through the pipes in the ground and back again into the tank. The heat of the ground is absorbed so greatly that it is frozen hard, in which state it is excavated. The shaft is down to the ledge on one side but, as before stated, the water comes in at another point, and they are temporarily stopped.

The company is no doubt anxious to complete this shaft, not only to get into the ore in this part of the mine, the existence of which has been shown by diamond drill boring, but also it is wanted for a pump shaft. It is in the low ground at the west end of the mine and will be made to take all the water. As it is now the pump shaft is at the east end of the mine on the top of the hill and there is no occasion for sinking it any deeper. When D and the one between it and C are sunk the mine will have four shafts, besides No. 5 shaft and A shaft.

The Chapin is a great deposit of ore, undoubtedly the largest of any in the State, but it is a weighty mining problem how to handle it the most economically. If the inclosing walls were jasper and quartzite, instead of

the soft, friable slate that they are, it would be much easier. There is one thing, however, to be considered in the matter of rock drifting in this mine: it don't cost much to do it, about $3.40 per foot. Such work in hard jasper would cost three times as much. I think that the cost of the ore, even with the crushing in of the drifts, and the added expense of making new ones, is much less than one might imagine. It is doubtful, in my mind, if the proposed plan, if carried out, will be found to be, on the whole, in the long run, better than the one now pursued.

The Chapin is one of the best equipped mines in the country. One sees very much that it is of interest there. Persons who are studying mining work or who take an interest in it cannot do better than to visit the Chapin.

The accompanying map is the same as printed in my last report. There is little change to be observed in the map except that B and C shafts have been sunk each 100 feet deeper.

The company works 900 men. The ore is about 63 per cent in iron and .073 per cent phosphorus. The ore in east end of mine is Bessemer.

The Chapin, the Norrie and the Minnesota are the three greatest iron mines at present on Lake Superior. All of them can send out a large product the ensuing year, but whether the Chapin management will endeavor to compete for the leadership I do not know. Of the three, however, I think that the Minnesota can at present produce more ore than any other mine on the lake. I have been there recently. There is a great deal of ore in sight available for stoping.

The annual product of the Chapin has been as follows:

Year.	Tons.	Year.	Tons.
1880	34,556	1885	177,987
1881	134,717	1886	198,871
1882	247,505	1887	334,026
1883	265,330	1888	290,872
1884	290,865		
Total			1,975,220

The capital stock is $2,000,000, divided into 80,000 shares, and the recent purchasers took the stock at its par value, $25 per share.

C. H. Cady, Agent, Iron Mountain, Mich.; Wm. Oliver, Mining Capt., Iron Mountain, Mich.; Ferdinand Schlessinger, President, Milwaukee, Wis.; William Schlessinger, Treasurer, New York, N. Y.; Adolph Wagner, Secretary.

Mr. Thomas, the superintendent of the work at D shaft, showed me some statements, sketches, etc., of the ground passed through in sinking. It is an interesting record, more especially the boulder deposits. It is astonishing the quantity and size of boulders encountered in this swamp many feet beneath the surface. Boulders of 14 tons weight were removed. The monthly product of the mine is now 35,000 tons.

THE WALPOLE MINE,

which is close to the east end of the Chapin, continues to be explored by the Menominee Mining Co., the former owners of the Chapin. The prospects of developing a paying mine do not seem to be very flattering, although some ore is found.

The shaft is down 300 feet deep, and they have three levels. The secret of the reason of keeping up the effort is that it is good ore—66 % in iron, and .006 % to .015 % in phos. The shaft is about 500 feet east of the Chapin.

The work is done by Pickands, Mather & Co., Cleveland, Ohio. C. H. Cady, Agent, Iron Mountain, Mich.

The lands are, E. ½, N. E. ¼ Sec. 31, and the S. E. ¼ Sec. 30, and S. W. ¼ Sec. 29, all in T. 40, R. 30.

No ore was shipped in 1888, but there are 5,000 tons in stock now, and they hope to increase it to 10,000 during the year.

THE MILLIE MINING CO.

operates the old Hewitt mine, south of the Chapin. It has never been a large mine, and there is little prospect of it ever becoming one. Up in this side hill at the east end of the Chapin, the ore lenses that have been found have all been small—always the best of ore but never much of it. This is the case with the Millie, as it was with the Hewitt—they are taking out good ore, but work in a small deposit. The new shaft is 170 feet deep, and the company employs 50 men. The officers remain as heretofore, except that Mr. C. W. Kennedy is the Supt., and there is a change in mining captains.

The amount shipped in 1888 was 10,722 tons, and there will be an equal or greater amount in 1889. The aggregate of shipments from this property is 51,491 tons.

John Corbis, Mining Captain.

THE PEWABIC MINING CO.'S

location is southeast from the Chapin, in the N. ½ Sec. 32, T. 40, R. 30. I visited the location March 16, and found a fine cage shaft sunk to a depth of 350 feet, and at the bottom a cross-cut north 800 feet. Near the end of this they find a seam of ore in which a winze has been sunk, and it seems to be of sufficient size to make quite a mine. Good blue ore, 63 %, and low in phos. Have already begun to make a stock pile from it. They use power drills, bringing the air from the main hydraulic works air pipe, that runs over the surface between the mine and the Chapin.

North of the shaft the ground rises, making a smooth, high, broad side hill, covered with pine and mixed timber, and made up, below surface, of jasper slates. The company is working about 30 men.

Jim Holland, Mining Capt., and Mr. Brown, former clerk at the East Vulcan mine, Supt.; N. P. Hulst, General Manager, Menominee Mining Co.

HAMILTON ORE CO.

has increased the depth of its shaft 336 feet since I last went down in it, a year ago. The shaft is now 1,256 feet deep vertically down. It has preëminence in one particular at least: it is the deepest vertical iron mining shaft in the State. For the last 500 feet it is sunk in ore. The bottom of the shaft has reached the red slates that belong to the foot wall in the Chapin.

The dip of the formation remains unchanged. The pump is successfully doing duty at the 920-foot level.

The following are analyses of the ore:

Iron..... 61.53 per cent.	Phos..... .057 per cent.	Iron..... 65.00 per cent.	Phos..... .076 per cent.
" ..... 61.52 " "	" ..... .026 " "	" ..... 65.50 " "	" ..... .105 " "
" ..... 59.21 " "	" ..... .057 " "	" ..... 61.56 " "	" ..... .053 " "
" ..... 60.36 " "	" ..... .068 " "	" ..... 67.90 " "	" ..... .045 " "

In the winze now sinking the ore analyzed: Iron, 65.15 per cent, phos., .074 per cent; shaft at depth of 1,195 feet, the ore went: Iron, 66.40 per cent, phos., .062 per cent; at depth of 1,200, ore sample gave: Iron, 67.60 per cent, phos., .073 per cent, and at 1,225 feet depth sample of ore gave: Iron, 64.90 per cent, phos., .060 per cent.

The shaft is in the corner of the property and is so placed that the diagonals of the rectangle of the cross section of the shaft are more nearly

parallel, respectively, with the boundaries of the property than are the sides of the shaft. They have not cross-cutted the ore north, but at the 1,025-foot level they have drifted east in ore 75 feet and sunk a winze 100 feet and come back to the shaft at the 1,125-foot level. This is all the opening work that has been done. They think that the ore goes east 150 feet anyway and must extend north the width of the deposit. They have no room west, as they are cut off there by the boundary of the property.

If they succeed in finding ore enough for a good mine it would hardly be safe to operate very largely with one shaft. The force employed is 60 men, and they have now—March 15—4,000 tons of ore in stock.

They are now putting in a Rand duplex compressor, 30″x18″, and two new steel boilers, 66″x16′, duplicates of the other two already in use.

The officers are: Norman Hall, President, Sharon, Pa.; P. L. Kimberly, Vice-President, Cleveland, O.; R. Williamson, Secretary and Treasurer, Chicago, Ill.; Frank Corbis, Mining Captain.

J. T. Jones, until now Superintendent, has severed his connection with the company. Since writing the foregoing this Co. has begun to sink another shaft.

The mine has sent out as follows:

1886	872 tons of ore.
1887	514 " "
1888	8,801 " "
Total	10,187 tons of ore.

THE LUDINGTON MINE

is just now—March 16—looking a little dubious in the bottom. A year ago when I went down into the mine the A shaft was sunk 60 feet below the eighth level and they were opening up the eighth. Now, A shaft is sunk to the tenth level and they are opening up the ninth, and where they expected to find ore is rock. That is, in going from the cross-cut south and east towards the main deposit jasper is encountered all the way where in the levels above was ore. What the outcome will be it is impossible to declare. They found some limestone in the ore in the eighth level.

The plan is to sink the shaft to the eleventh level, 1,007 feet deep, 100 feet below its present bottom, and ascertain if the rock will not cut out.

In the ninth, 907 feet below surface, the first 20 feet east of the cross-cut was ore, since which the whole drift, 125 feet, has been in rock. Mr. Moore expresses the intention of working with a diamond drill in the bottom to explore it. A shaft is 261 feet west of the Hamilton shaft, and it would seem that the ore which is found in the latter must extend into the Luding-

ton land, and inasmuch as the Hamilton shaft, close to the Ludington line, is still in ore 1,256 feet down, and has been for 500 feet, it would indicate that the Ludington has still undeveloped ore, possibly a good deal of it. The drift which they are opening to connect with the old mine, 1,000 feet west from No. 5 shaft, is now 900 feet long. No ore has been cut in this drift. The old mine and No. 5 shaft, both yield all Bessemer ore. The large body of ore next to the Chapin line is non-Bessemer. The former is designated as Ludington ore; the latter as Star ore. The company works 240 men.

The Ludington ore goes 67.7 per cent iron, .021 per cent phos.

The Star ore goes 64 to 65 per cent iron, .095 per cent phos.

The Ludington mine has annually produced as follows:

Year.	Tons.	Year.	Tons.
1880	8,876	1885	124,194
1881	3,365	1886	76,983
1882	52,519	1887	104,289
1883	102,632	1888	61,883
1884	101,165		
Total			635,906

The mine is in the northeast corner of the S. $\frac{1}{2}$, S. E. $\frac{1}{4}$, S. 25, T. 40, R. 31.

A. D. Moore, General Manager, Iron Mountain, Mich.

Of the

CORNELL, TRADERS', CANADIAN, INDIANA, ETC.,

mines, in the vicinity of Iron Mountain, there is nothing to mention beyond the fact that all work and exploration has ceased for the present, at least. They are all idle.

But going west on the C. & N. W. R. R., we cross the Menominee river and get into Wisconsin, and are brought first to

THE COMMONWEALTH,

which is a valuable mine, held in fee simple by the company, and which produces a good quality of non-Bessemer ore.

Capt. W. E. Dickinson, who has been Supt. of the mine since 1883, resigned about the close of the year 1888, to assume the charge of the Colby. Mr. O. C. Davidson has been appointed in his stead. The company employs now 120 men, and the mine is looking fully as well as usual.

The mine has produced each year as follows:

Year.	Tons.	Year.	Tons.
1881	97,410	1885	42,947
1882	115,865	1886	51,189
1883	21,943	1887	57,000
1884	34,622	1888	61,818
Total			482,794

THE FLORENCE MINE

is also in the State of Wisconsin, but as it and the Commonwealth are the only two producing mines in the Menominee range in that State, and as they have the outlet for their ores at Escanaba, I have always included a description of them with the others, especially of the Florence as it is an interesting and valuable mine. The company owns three-quarters of the fee, the remaining fourth being held by D. H. Fisher, Esq., of Florence, to whom the company pays 6¼ cents per ton royalty. The Florence is a well managed and well worked mine and it contains a great amount of ore that is cheaply obtained.

Not much is done in the old mine, the ore is low grade, but for the past few years, since the mine came into the possession of the present Co., the work has all been off to the west in the new deposits known as No. 4 and No. 5 shafts. Here they have opened a length of ore 200 ft. and still continuing in No. 4 shaft in the 300 ft. level in the south lense. At the east end the stope is 18 feet wide, and at the west end it is 40 ft. and 70 feet high. It is clean ore, no rock in it. The north lense in No. 4 shaft is harder ore, about the same in quality as the other, all of it yielding 61½ to 62 per cent in iron and about .20 per cent phosphorus. Are sending 200 tons daily to Chicago Furnace Co., and have 25,000 tons in stock.

No. 4 shaft is 350 ft. deep and No. 5 is 300 and sinking to the 350 ft. level. The hoisting is mainly in No. 4, but are beginning to send up ore in No. 5. The walls in the mine stand remarkably well, like those in the Norway.

In July last the engine house was burned, but the utmost exertion was expended and it was speedily rebuilt and is now much better and better arranged than before.

In the old mine, No. 2 shaft, they are preparing to mine out 25,000 tons of ore that is contained in pillars and in the back or floor between the bottom of the open pit and a level beneath it. This will be very cheap ore.

Two Norwalk compressors have been added to the machinery. The mine is situated in the west part of the city of Florence and is lacking in nothing essential to vigorous and economical work. The company employs now (March 19) 200 men, but soon the force will be doubled or greatly increased.

The mine has produced each year as follows:

Year.	Tons.	Year.	Tons.
1880	14,143	1886	840
1881	100,501	1887	79,399
1883	160,155	1888	142,586
Total			537,856

Henry Tod, President, Youngstown, O.; J. N. Porter, General Manager, Stambaugh, Mich.; J. E. Gilbert, Superintendent, Florence, Wis.; Edward Ball, Mining Captain.

THE IRON RIVER MINE

has never looked better than it does now. It shipped last year 110,000 tons of ore and worked very light until late in the season. The mine could as easily yield 200,000 tons.

The south part of the north end of the mine is somewhat irregular but north of it, to No. 3 shaft and beyond, the deposit is regular. It is to the 200-foot level and all the ore is extending from that depth 80 feet up. Between it and the 120-foot level at each 50 feet a winze is made for sending down rock to fill up with. They back stope the ore and fill up with rock, rising up on the filling.

The ore has a uniform width of 40 feet for a length of 500 feet. It is reached from No. 1 shaft, which is sunk to the 300-foot level, and is a double skip shaft. The mine is opened for all the product that can be disposed of. They hope to sell 200,000 tons. No. 3 shaft is west of the ore towards the river in the hanging wall, 123 feet from the ore. But in driving the cross-cut from this shaft at the 200-foot level they have cut 60 feet in width of ore—an entirely new body of whose existence they previously knew nothing.

In mining out the 80 feet in height of ore that I before mentioned, the rock for filling will come down through the winzes that have already been made; and as they rise up, "mills" in which to run down the ore into the drift will be kept open through the filling. The material for filling comes from the sides of the open pit. The only timber used is in the drift to be

kept open for tramming ore. It looks very much as if the ore will finally be found to extend under the river. They are preparing to bore with a diamond drill in the swamp by the side of the road south of the shafts.

The Isabella pit, away to the south end of the section, is also holding its own. The pit is becoming very deep for an open one—200 feet. The ore has taken a pitch south and gone under the south wall of the pit. It will give as large an annual product as ever. This pit is in the S. W. $\frac{1}{4}$ of S. W. $\frac{1}{4}$, Sec. 36, T. 43, R. 35.

Isabella pit product, 1888	43,570 tons of ore
North End mine product, 1888	66,382 " "
Total	109,952 tons of ore.

The annual product has been as follows:

Year.	Tons.	Year.	Tons.
1882	29,115	1886	78,591
1883	100,369	1887	82,464
1884	52,584	1888	109,952
1885	55,693		
Total			508,768

The North End ore averaged 57 per cent to 58 per cent in iron and the South End, or Isabella ore averaged 60 per cent iron; phos., .33 per cent.

Everything at the Iron River mine shows the best of management and care.

J. N. Porter, General Manager; Otto Riebel, Superintendent.

The Iron River mine is at Stambaugh, Mich., in Secs. 35 and 36, T. 43, R. 35, Mich.

THE NANAIMO MINE

was closed down last summer, mainly, I believe through the failure of the company to meet its pecuniary obligations. I happened to be at Iron River in June when work was suspended at the mine. The pumps were pulled out, etc., and the sheriff was attaching property to secure payment for debts, particularly labor accounts.

The ore on hand was taken by Todd, Stambaugh & Co., of Cleveland, to whom it had been sold to pay advances of funds.

I do not think that the mine is likely to be opened again soon. There is ore in the bottom still. How much could be found cannot be said as there is no advanced opening work, but it is a quality of ore that must be mined

very cheaply and in large quantity to make any profit. It is the same practically, as the Iron River mine ore (57 per cent, 58 per cent) and there is not nearly as much of it as at the Iron River mine, and the Iron River Co. cannot sell enough ore to keep the mine working throughout the year.

The Nanaimo is in the village of Iron River, Mich., in the N. W. ¼, S. W. ¼, Sec. 25, T. 43, R. 35, held on a lease by the Nanaimo Co. and owned in fee by the McKinnon Bros., Iron River, Mich. I understand that the Co. has relinquished its lease of the land. The mine was opened in 1882, and has yielded an aggregate product of 110,915 tons of ore. The product in 1888 was 5,744 tons.

THE BETA,

which is a small pit close to the Nanaimo, has not been worked the past year. They worked out a pocket of ore in 1886 and 1887 that yielded 2,811 tons. Mr. D. C. McKinnon, Iron River, Mich., is the owner of the fee of the land.

THE SHERIDAN

joins the Beta. Mr. P. Sheridan has been exploring the proporty several years and proposes to continue to do so in 1889. He has not sent away any ore yet, but thinks he will be able to ship some the coming season. Work will be prosecuted under direction of Capt. Wm. Morgan.

These are all the mines to mention in the vicinity of Iron River, but further east 12 or 15 miles in township 43, R. 32 and 33, is

THE PAINT RIVER DISTRICT,

where are a greater number of mines and considerable mining activity. New developments are constantly made and deposits of ore found, some of good quality; but no Bessemer ore, in quantity, has been discovered west of Iron Mountain. What is called the east range at Crystal Falls, in Secs. 13 and 23, etc., T. 43, R. 32, will contain, in 1889, mines that will be shipping ore, and thus more will be known about the quantity and the quality of the ore in these new "finds." The Chicago & Northwestern Railway Company has built a branch to the Smith that will be extended to the other new mines as they may require for the purpose of shipping ore.

Further north in T. 44, R. 31, Sec. 4, considerable exploring work has been done and is still in progress. Messrs. Wilson and Pascoe, of the Republic, who own an interest in the fee of the land and who are directing the work, tell me that they have an abundance of hematite ore that averages

above 60 per cent in iron but is non-Bessemer. The ore is 60 feet wide and they have sunk 120 feet. Capt. E. S. Roberts now has charge of the work.

Other explorations in this locality are said to be also showing well. I have seen analyses of ore found here that indicated good non-Bessemer ore.

THE HOLLISTER EXPLORATION,

being the W. ½ of the W. ½ Sec. 13, T. 43, R. 32, which I examined a year ago and described in my last report, has been further developed with good results.

Mr. Hollister has begun the work of "stripping" the ore; that is, removing the covering of dirt, preliminary to mining the ore. He hopes before the end of the season to have sent out a considerable product. Judging from the indications so far, the prospects for realizing his expectations are good.

Mr. Hollister has explored quite systematically and thoroughly, by test pits and shafts, and the showing justifies the further work which he has determined on.

Capt. John Morrison superintends the work.

THE ARMENIA MINE,

as the Smith is hereafter to be called, in the E. ½ of the S. E. ¼ of Sec. 23, T. 43, R. 32, has changed owners, the lease having been purchased by the same parties who own the York mine.

I went out to the mine a few days ago—March 25—and found that the new proprietors had made a great alteration in the appearance of the location. Where but a few months ago was unbroken forest, a log shanty or two and a few freshly made test pits, is now a busy mining location—boarding houses, dwelling houses, shops, engine house, machinery, shafts started, skip road operating, railroad built, and all the noise and bustle of active work.

The company has stripped the ore for a length of about 150 feet and a width of 80 feet. The covering is heavy, and now that it is removed for quite a space it is, even yet, not easy to form a judgment as to the prospects of the mine. The bottom is not all ore. The formation is irregular. It is impossible to give the strike and dip from the appearance of the rocks in the pit. It is supposed that the ore and the formation here lie north and south; and probably they do, still the development so far does not determine. All that was known previously was that a shaft, 60 feet deep, was

all the way from the ledge down in ore, and that they had drifted east and west—cross-cutted they called it—80 feet and upwards in ore. It was on this showing that the property was sold; nothing more was known. It was assumed that there was a body of ore 80 feet or 100 feet wide and of indefinite length, but I confess to a little of disappointment in the appearance of the opening—there was more rock than I expected to find. But as I said, one can form a judgment of the value of the mine better by and by, after it has been developed more.

Mr. Florada and the other gentlemen in charge express entire confidence in the mine. Certainly they are making every preparation for a large mine. South of the open pit a shaft is sinking, and is nearly down to the depth proposed—100 feet. The purpose is to drift north from the bottom of the shaft, under the open pit, for a stope. They have a 100-horse power engine and two 5′ Lane drums, well placed in an engine house, also capacious ore docks, and are building ore pockets. The company has a dynamo machine and lamps for electric light illumination. The force employed now is about 75 men, and a big product is talked of outside, though I do not know that the officers express any opinion as to the amount to be shipped.

I am informed that the "Smith" is not a corporation, but is worked by the York Iron Co. management. F. Schlessinger, President; Edward Florada, Gen'l Manager; —— Wilcox, Supt.; A. J. Carlin, Mining Capt.

The same gentlemen own the Smith, it is said, who have recently purchased the Chapin, and who also own the York—formerly the Dunn.

There are other explorations in this east range that have more or less promise, some of which will, no doubt, develop into mines if the Hollister and Smith turn out well. But as yet they are only explorations—in Secs. 13, 14, 23, 26, etc., T. 43, R. 32.

The Dunn mine, as it is universally called, but owned and worked by

THE YORK IRON CO.,

has made an unusual record in 1888 and the year's work has no doubt resulted profitably to the owners. The mine is in Sec. 1, S. W. ¼ N. W. ¼ and N. ½ S. W. ¼, T. 42, R. 33, two and one-half miles south of the village of Crystal Falls. For a new mine, open cut, 118,091 tons is a large product. The ore is non-Bessemer and so must have sold at a low price to have marketed so great a product.

The Dunn last year presented one of those fortunate conditions that sometimes occur, as did the Iron River mine in 1883: That is a wide deposit of clean ore all stripped ready for stoping and presenting the most favorable

conditions for the cheapest mining. But while the mine is in good shape and well handled I do not think it likely that as large a product will be obtained the coming year or that the ore can be mined as cheaply as it has been. The mine is deeper and there are more difficulties to encounter that add to the expenses to overcome. The mine is near the east line of the land and the ore runs north and south. So far it appears to be in two lenses, the one lapping the other, separated by jasper. The north lense is open cut and the south one is worked underground, but the intention is to strip this also after they have moved the engine house from its present site partially over the ore to the foot wall side of the mine. The dip appears to be to the west, though there is little indication of dip. They were stripping from the east wall of the north pit partly for safety. The ore has a maximum width of 100 feet and an aggregate length north and south of 600 feet. The walls are schist, quartz schist, jasper schist, and need looking to for safety of the men. The company is erecting additional ore pockets and also building some additional dwellings.

The product: 1887, 25,470 tons; 1888, 118,091 tons.

The officers remain as heretofore: Ferdinand Schlesinger, President; H. Schlesinger, Secretary; Edward Florada, Superintendent, Crystal Falls, Mich.; F. C. Bennett, Mining Captain.

THE MASTODON MINE,

situated about two miles south of the Dunn, in the S. ½ N. E. ¼ Sec. 13, T. 42, R. 33, is a peculiar affair. Standing on the surface and looking down into the deep yawning chasm from which the ore has been extracted one can scarcely persuade himself that is quite safe. The mine is unlike most open pits, however wide and deep, they are all open to the sky. The Mastodon is open to the sunlight, but also there is an immense chamber to the west with a wide expanse of roof that rests partially on the pillars that buttress the high portal separating the rooms. The great roof arching this chamber must awaken apprehensions of danger in the breasts of timid persons standing under it.

When I was at the mine—the last of March—they were stripping south a heavy depth of surface, 30 feet I should judge, for the purpose of uncovering a back of ore that forms the roof to a flat chamber that was mined out a few years ago.

The shaft is north of the pit, and between it and the winze at the south end of the chamber where the stripping is going on, is 500 feet, ore all the way. The bottom is all of ore, and the pillar, north, which separates the

open pit and the west chamber, is 120 feet long, 20 to 40 feet wide. The shaft is sunk one lift below the bottom of the open pit, and a drift has come south under the bottom for a stope. This, with the pillar and the back in the south chamber, suffice for a large product of ore. In stripping they are running the dirt below to fill the room, at bottom of which is a "horse" of jasper. The ore went up over it, between it and the sand.

The shaft is 200 feet deep, in rock—cross-cut to the ore. Recently have discovered a new lead of ore, east of the bottom of the shaft, that is going off to the northeast—an entirely new find, and in a different course from the other ore. A new cage will be put in the shaft, one having just arrived for it. The mine is well provided with machinery—two 5′ drums, Marinette make, in a new building. The old engine house is used for duplex compressor.

The company paid $2.00 per share dividend in 1888.

C. T. Roberts, Agent, Crystal Falls, Mich.; Joseph Austrian, Secretary and Treasurer, Chicago

The mine has produced as follows:

Year.	Tons.	Year.	Tons.
1882	3,477	1886	41,640
1883	18,577	1887	49,115
1884	18,020	1888	51,293
1885	11,773		
Total			193,859

THE SOUTH MASTODON

shaft is but a short distance south from the Mastodon open pit. I descended to the bottom of the shaft a few days since—March 20—and examined the drifts, etc. I found a drift going east 20 feet and one west 40 feet; also drifts at 130 feet down. Both shaft and drifts are in mixed ore and rock. There don't seem to be any change in it. There is clean ore in places, but it don't hold out, rock comes in again speedily, not all rock, but enough to spoil the ore and to make it valueless. Mr. Blake was in something of a quandary as to what to do, whether to go deeper, which way to drive, etc. I think it likely he will conclude to start in a winze at the south end of the Mastodon, and drift from the bottom of it southeast into the low ground on his own property, and perhaps also put a diamond drill at work in the bottom of the shaft.

The success has not been as good as was hoped for a year ago when the ore was first found in the shaft. The formation is banded jaspery schist, with mixture of quartz in places. The surface on the west rises into a hill and east of the shaft and north is low level ground.

The mine is near the south end of the valley where the opposite ranges of hills have approached each other until they have nearly terminated it.

It was expected to find a lense underlying the Mastodon, possibly it may be found lying deeper or further east. The indications seem favorable for ore.

Edward Blake, a gentleman long connected with the Jackson Iron Co., has charge of the work and is pecuniarily interested in the enterprise. I should say he is working very judiciously and has done nothing amiss. The description of the land is N. ½ of the S. E. ¼, Sec. 13, T. 42, R. 33.

Daniel H. Ball, President; Edward Blake, Secretary, Mastodon, Mich.

The product 1888 was 2,722 tons.

THE YOUNGSTOWN MINE,

in the E. ½ Sec. 19 and S. W. ¼ Sec. 20, T. 43, R. 32, is idle, and the General Manager, Mr. J. N. Porter, tells me that it will not be worked the coming year. In fact the company has relinquished the lease which it held on Sec. 19, the west part of the mine, having decided that it had as much of this class of ore in the Nelson shaft, or in the land in Sec. 20, which it holds on a lease from Robert Nelson, Esq. The portion of the mine in Sec. 19 was the first explored and the part from which all the product was taken in 1881–2–3. The large engine house and machinery are also at the west end of the mine which the company will sell or remove.

The mine, that is all the shafts and ore deposits are in what was originally a wet, cedar swamp, bounded on the south by a side hill, parallel with which are the shafts. The ore runs nearly east and west and north of it 40 rods is Butler creek that crosses east and into the Paint river, a quarter of a mile away. The railroad track (C. & N. W.) runs along south of the shafts and the long ore dock is made by building up the crib work beside the track and digging out the hill and leveling off sufficiently to give the requisite room for stocking a great deal of ore. The fact is the Youngstown was laid out for a large mine. The fact of having very much ore was ascertained and the plans were made for handling it to advantage. But the ore is of poor quality and under the conditions of the market for the past few years it has been impossible to sell it at a profit, for which reason the mine has not been much worked.

In the Nelson shaft, near the west line of the section, the company has a width of ore of 200 feet or more. The shaft is 160 feet deep and the mine is well opened ready to take out ore in abundance.

The ore averages about as follows:

Metallic iron	54.50 per cent.
Phosphorus	.57 " "
Silica	3.00 " "
Manganese	4.50 " "
Lime	2.50 " "
Alumina	1.30 " "
Water	6.00 " "

It is reported that Mr. C. T. McElroy, of Norway, Mich., has leased the Sec. 19 part of the mine and is making an effort to interest capital to work it. The Youngstown was opened, etc., by the Briar Hill Coal & Iron Co., Youngstown, Ohio.

J. N. Porter, General Manager, Stambaugh, Mich.

The mine has yielded as follows:

Year.	Tons.	Year.	Tons.
1882	6,198	1886	25,638
1883	15,292	1887	34,418
1884	8,343	1888	12,700
Total			102,587

THE QUINCY

being in section 19, joining the Youngstown on the west, is also being explored by Mr. C. T. McElroy, of Norway, Mich. The same was explored in 1881–2, etc., by Mr. Jos. Ames and others and abandoned. They experienced much difficulty in getting to the ledge and failed to find much ore.

THE MONITOR IRON MINING CO.

is working lot 6, S. E. ¼ of Sec. 20, T. 43, R. 32, being east of the Youngstown, in the same section, on the opposite side of the river. The ore is of the same quality as that found in the Nelson shaft, an analysis of which is shown on the previous page. But there is a fine body of it and they are getting it out very cheaply. The shaft is close to the east line and is in the same ore that extends across the line and is also worked in the Paint River mine. It is 87 feet deep and the opening west is 200 ft. all the way in ore, which has a maximum width of 67 ft. The axis of the ore deposit seems to

be towards the old shaft that was worked in 1880–1 at the falls by the Crystal Falls Mining Co. This body of ore is in the low land.

The company is working 30 men and raising 110 tons per day, dumping it into cars, as there are no pockets or room for stocking it about the shaft. It goes to the Chicago Furnace Co. It is a body of clean, low grade, non-Bessemer, hematite ore. The machinery is very simple, a small exploring engine and hoist, using a wooden bucket—one-half of a kerosene barrel.

Capt. Frank Rahrer, who has lived on this land a number of years and spent time and money in exploring it, has charge of the mine.

W. S. Coffman, President and Treasurer; Frank H. Rood, Secretary, 185 Dearborn street, Chicago, Ill.

Product 1889—2,690 tons.

THE PAINT RIVER MINE

has been idle all winter, but now—March 10—they are preparing to work again. The work that was doing when I was at the mine was in the lower portion of B shaft, the one next to the west line, close to the Monitor. This shaft is 150 feet deep; for 110 feet of which distance it is straight. The remaining 40 feet is the portion that they are straightening, making it line with the upper part—that is, making it vertical.

East of B is an open pit now, caused by the sinking or "caving in" of the ground around A shaft two years ago. A skip track goes down on the north side of this pit, 180 feet east of B.

From the line east they have a length of 200 feet and upwards of ore, 26 feet to 57 feet wide; the latter width is found at A shaft, 50 feet east of B. When B shaft is in readiness they will open up a level below the former workings and "room out." There is no ore in stock. Capt. C. T. Roberts has the contract for mining the ore at 90 cents per ton, and has Capt. Robert Phillips on the ground to look after the work. Also his assistant, Mr. Frank Scadden, gives to it a more general superintendence. The other officers are: Madison LaMonte, President, Chicago; Wm. Eisenbath, Secretary and Treasurer, Chicago; M. R. Hunt, General Manager, De Pere, Wis.; C. T. Roberts, Superintendent.

The annual production has been as follows:

Year.	Tons.	Year.	Tons.
1882	4,615	1886	13,933
1883	5,971	1887	10,240
1884	11,546	1888	12,506
1885	2,374		
Total			71,185

THE GREAT WESTERN MINE

was closed down on the 26th of June last and remained idle until February 5, when the pumps were again started and the effort begun to pump out the water. It has proved to be a difficult matter for now—March 21—the work is not yet accomplished. Capt. Hooper states that he is pumping 1,100 gallons per minute, using a No. 11, a No. 10 and No. 9 Cameron pump, and are just holding the water. There will soon be at work in addition a Worthington pump which, it is assumed, will soon get rid of the surplus water. They did have at work two Knowles and one Dean pump until the No. 11 Cameron was reached. Just now the spring break up is on and as the mine is in the hollow it gets much surface water. They have a long plank launder to carry off the water down by the railroad track to the west.

As I have described in former reports, the Iron Star is a very wet mine. Twelve days after the pumps stopped last June the mine was full of water. It was closed down, it is said, on account of the state of the ore market during the early part of the season in 1888, but later, when the outlook became more favorable, the fact of having stopped was regretted.

Capt. Hooper assures me that the mine is showing as well as usual. It is not greatly opened for the ensuing summer's work, but there is every prospect that when the opening work is done there can be as much ore or even more than has ever been taken from the mine, in a given length of time, obtained.

The shafts are to the fifth level. No. 1, the west shaft, is 275 feet deep. North of the shaft is a drift 70 feet and east 40 feet, all in ore. The bottom level of the mine is at the horizon of the ore, which was found with a diamond drill several years ago in the east part of the mine, north of the other lenses. This ore was struck at 237 feet down and the drill went through 90 feet of it. The hole is 240 feet east of No. 3 shaft. It is also west and north of No. 7 room, the one under the engine house.

East of No. 3 100 ft. is a pocket of ore that is good both in the fourth

and in the fifth levels. The mine is made up of a number of independent pockets of ore on which not much dependence can be placed as to their continuance. They may be good in one level and greatly diminish or play out in the next, so that it is difficult to base predictions of future results on present appearance of the mine. But as Capt. Hooper says the old pits average all right, the new deposit will also come in, and so quite likely Capt. Hooper's estimate of 35,000 tons for the product of 1889 may be realized.

The mine yields some very valuable ore. I have just seen several analyses of samples of it that gave 68.40 %, 67.30 %, 61.50%, etc., in iron and nearly within the Bessemer limit in phosphorus; but the mine is so wet, the pockets of ore are so small that it is rather an expensive mine to operate, and the constant and universal dripping of the water makes it disagreeable to the men.

The mine has produced as follows:

Year.	Tons.	Year.	Tons.
1882	587	1886	25,725
1883	22,825	1887	23,239
1884	20,722	1888	21,861
Total			114,959

The location is about a mile in direct line from the village of Crystal Falls, in section 21, T. 43, R. 32.

The mine still retains its old name, though it is operated by the Iron Star Co.

V. K. Moore, Secretary and General Manager, Detroit, Mich. Wm. Hooper, Superintendent, etc., Crystal Falls, Mich.

THE FAIRBANKS MINE,

which lies between the Iron Star and the Paint River mines, remains idle, as does also

THE SHELDON AND SHAFER,

in the N. W. $\frac{1}{4}$, Sec. 31 and the S. W. $\frac{1}{4}$, Sec. 30, T. 43, R. 32. The Messrs. Sheldon, of Houghton, and J. F. Shafer own the fee of the land and, I believe, wish to sell or lease it. I have described the mine in former reports and there is nothing to add that I know of. There has been shipped from the mine as follows:

Year.	Tons.	Year.	Tons.
1882	15,947	1886	14,282
1883	4,334	1887	2,379
1884	6,774	1888	10,936
1885			
Total			54,652

I am informed that Mr. Shafer has leased the half owned by the Messrs. Sheldon and will operate the mine in 1889.

THE JUNIATA,

Dr. H. C. Kimball's mine, in the S. E. ¼, S. E. ¼, Sec. 28, T. 43, R. 32, has been idle during 1888. I described the mine in my last report, and can add nothing of interest.

THE CALEDONIA MINE

in Sections 17 and 20, T. 43, R. 31, is simply an exploration which I have heretofore quite fully described. It is reported that work on this property will be resumed by Messrs. E. E. Keyes, A. E. Guensburg, W. R. Calhoun and others.

Some good ore was formerly found in the drift from the shaft sunk here. It is perhaps worth further exploration.

THE LEE PECK,

owned by J. M. Case, of Marquette, has not been worked since the date of my last report. It is in the S. W. ¼, N. E. ¼, Sec. 26, T. 43, R. 32, in the center of the land, and though a favorable, is not a large showing of ore.

Mr. H. B. Swain had charge of the work.

THE WAUNETA,

heretofore the Blany, of which Mr. Swain also had charge, has not been further worked in 1888. As I before stated, the future of these and other properties lying east of Crystal Falls, will depend much upon the outcome of the work at the Smith and Hollister mines, where they are developing more largely and will soon be shipping ore.

THE FELCH MOUNTAIN DISTRICT

has nearly ceased to be the scene of any mining work; 3,490 tons of ore were sent away from the Metropolitan mine in 1888 and none from any other. Some work was prosecuted at

THE GROVELAND MINE,

in the S. ½, S. W. ¼, Sec. 32, and other lands held by the company, constituting what they call the East Groveland, Groveland and the West Groveland. I have not been to the property lately. I do not think it is likely that any of them will be shipping ore very soon.

THE GOGEBIC IRON RANGE.

In no mining district of the State has the development ever been so rapid and remarkable as in the Gogebic range. The occurrence of the iron bearing rocks in this portion of the State was only first mentioned in the State geological report, 1873. But not until 1880 was there any actual searching for iron ore, and then to a limited extent. In about 1883 ore was found at the Colby in sufficient quantity to insure a mine of large proportions, and elsewhere the indications were found to be such as to warrant the building of a railroad from Ashland to the range and thence to Milwaukee, over which the first shipment of ore was made in October, 1884. Up to 1885 the work done was mainly exploratory; only test pits had been dug, and except at the Colby scarcely any regular mining work had been begun. The years 1885 and '86 were very active ones in this range. A vast amount of exploring work was done, some good mines opened, and a great deal of substantial progress made. It is astonishing to visit that range now, after so brief a period and to note the change. Where but four years ago was an almost unbroken wilderness is now a region abounding in activity, evidences of wealth and of present and future prosperity. The cities of Ironwood and Bessemer cannot be surpassed in the State for size and substantial growth in the period of time since they were started. Fine school, church and other public buildings, graded streets, sidewalks, water works, electric lights, four lines of railroads—in fact everything is here that is found in the long settled and wealthy portions of the country.

The facilities for shipping ore from the mines of this range are good. Ore is sent by the Milwaukee, Lake Shore & Western and the Wisconsin Central to Ashland and by the Chicago & Northwestern to Escanaba. Over all

these lines ore is sent to other points by all rail shipment. Complaint is made, however, that the rates, both rail and water, are too high—70 cents per ton to Ashland and $1.25 thence to Cleveland. To this add 50 cents per ton royalty, which some of the mines pay, and nearly one-half of the amount received per ton for the ore is accounted for.

Early in the work in this section very much was claimed for the extraordinary richness of the ore and more especially for the cheapness for which it could be mined. The ore is certainly good and there is no falling off in this respect, but as for cheapness in mining this range corresponds with others in this particular. The Colby, the earliest opened of the mines, presented exceptional facilities for cheap mining. An extraordinary large body of ore that came to the surface at the western end of a bluff so that for the first season the ore was loaded directly into the railroad cars from the stopes; the cars taken into and out of the mine by the locomotive. On the basis of what was done at the Colby the impression was created that ore could everywhere be found in this range and could be mined far more cheaply than elsewhere. However, it is well enough understood now that it is as much and as expensive work to find ore here as it is anywhere and that in the long run it costs the same to mine it. The mines become deeper and more powerful machinery must be provided and other expensive changes made. Such is the condition now at several important mines.

The Gogebic range, in one particular, at least, is exceptional: the formation is far more regular than in the other iron ranges of the State. Commencing at Gogebic lake and going slightly south of west a distance of 80 miles, the range presents nearly the same regularity. The Huronian series rest upon the granite to the south and are overlaid by the Keweenaw series on the north. It is made up of schist, fragmental quartzite, cherty ferruginous schist and ore bodies; slates, quartzite, gray wacke, schists, etc. North, in the slates and gray wacke, occur protrusions of granite—sienitic granite. These latter I have observed at several points north of Marenisco, in T. 47, R. 43. From the east line of T. 47 N., R. 46 W., where the range is cut through by the Black river, west to Penoka Gap, Wis., the formation is unchanged: that is, the fragmental quartzite belt extends the entire distance, and on it, or near it, all the workable bodies of ore that have been found rest.

Within the limits above mentioned the ore in all the mines lies on the quartzite, except at the Iron King, Pabst and Colby mines. From the fact that ore was found on the quartzite and again at about 400 feet north of it, at the Colby, and also at the Iron King mine, arose the theory of two ore veins; and even yet it is customary to speak of the north and south veins.

At the Colby, however, the so-called north and south veins were ultimately found to be one and the same. The deposit was divided by the "cap rock" and a roll in the underlying dike which allow the ore bodies to come together lower down.

West of the Black river no workable deposit of ore has been found at a greater distance north than 400 or 500 ft. from the foot wall, and this at the Iron King and Pabst, contiguous mines working in the same deposit, and at the Colby. The rock in which are the mines, immediately overlying the quartzite, is a ferruginous, cherty schist, and north of this is black slate, etc. The formation dips at a high angle 60° to 70° north, and is nowhere folded. It is cut, adjacent to the foot wall, by dikes that so frequently occur that they are found in all the mines. With a single exception they all dip to the southeast. The exception is the main dike found in the Iron King and Pabst mines, in the north vein that dips to the southwest. They were originally diorite, but have been so changed that almost none of the original material is left, but they still possess the diabasic structure.

The dike rock is generally soft, sometimes soft and of a greasy feel like tallow or hard soap. Occasionally it is found somewhat hard and approximating to greenstone, which it originally was. The miners call it soap stone. These dikes are an important factor of the Gogebic range, inasmuch as the ore deposits of every mine west of Black river rests on one. And it remains to be shown to what extent they limit or cut off the ore. So far it is pretty certain that ore does not exist immediately under any large dike. In several of the mines, as will be more fully explained further on, shafts have been sunk through the underlying dike and borings made also with diamond drill, but in no instance has ore been found. The rock found under the dikes is identical with that occurring above, designated as "cap rock."

Since along the range for the whole distance west of Black river, there is a succession of dikes, and where the ore exists it is found lying on them, the belief is entertained that ore will be found under the dikes; that in each case if they only go deep enough the lense of ore will be reached, coming in from the west and carried above the dike which limits it. The theory is held that the deposits of ore resulted from precipitation, the iron being derived from the carbonates, etc., contained in the formation and carried in solution by the percolating waters through the porous rocks until reaching the hard quartzite belt and the compact dike which the waters were unable to penetrate, and thus coming to a rest the iron held in suspension in these places was precipitated, resulting in the process of time in the accumulating of the deposits of ore as we now find them.

If this is the true theory of the formation of the ore deposits, it would seem, contrary to the expressed opinion, to render it improbable that the ore should continue to great depth. Since water being the indispensable agent is cut off from percolating below, by reason of the imperviousness of the dike which it reaches and which it follows until brought to rest where it deposits the iron held in suspension or solution. Thus the rock beneath this dike, receiving little or no water, could not be acted on by this dissolvent, and hence can contain no deposits of ore. There are small dikes in several of the mines which do not cut out the ore, but they make more or less difference in its character. Generally the ore or rock in contact with a dike is hard, however soft the deposit may be further away, and if ore occurs under the dike it is harder and contains sand boulders, "nigger heads," concretions of ore, etc., while above, the ore will be soft and uniform except very near the surface of contact.

East of the Black river there are no working mines except at Sunday lake. The quartzite foot wall, so important a feature of the formation further west, is here wanting; there are also no dikes. The dip and regularity of the formation remain the same.

There is a much wider belt than further west, of the ore, containing sediments, ferruginous schists, etc., but only two or three workable deposits have been discovered, which are at the east side of Sunday lake.

There has been a great deal of exploring done in the Gogebic range; throughout the entire distance from Gogebic lake to Penokee Gap there is almost a continuous line of exploring camps and mines. Most of the pits, which are dug, did not reach the ledge, but where they did are bottomed in slate. Nearly all of these explorations have been abandoned, or at least are now idle. Further effort made at some future time may result more fortunately.

The best mines in the range are in this State between the Black and the Montreal rivers, and commencing at the latter point, the western boundary of the State. I will describe the mines in succession to the east, thus beginning with the

ASHLAND,

which is greatly improved since a year ago. The mine is now in admirable shape, well opened, and the improvements, which are making in the way of machinery and shaft houses, etc., will soon place the Ashland in the lead in the matter of equipment among the mines of this range. A great change for the better has been made on the surface. Everything has been transferred to the foot wall side of the mine; a new engine house and boiler

house have been built and a new plant of machinery procured, consisting of three 10-ft. drums and engine, Webster, Camp & Lane manufacture. They are all on the best foundation, and room is made for the fourth drum, to be added when required. There will be six boilers, though they are not all in yet. They are now building—June 1—new shaft houses at No. 4 and No. 6 shafts, very large and strong, 80 feet from sill to plate. At each will be ore pockets with capacity of 300 to 500 tons each. The railroad tracks are also on the foot wall side and they have thus plenty of room and entire security. There is a stock pile of 50,000 tons of as fine looking ore as can be found on the range. Averages 65 per cent in iron, .040 per cent phosphorus. In the fifth level of the mine, in the east end, the ore is of still better quality, showing 67 per cent iron and as low as .012 per cent phosphorus.

At the close of last season's shipments the stopes in the mine were all exhausted; the report showed only about 9,000 tons of ore available for stoping! But the opening work has been pushed forward during the winter, so that when the new shaft houses and machinery are ready they can produce ore rapidly. The mine has eight shafts in all, being at intervals along the foot wall for half of a mile. No. 1 is at the west end and is sunk to the dike and is exhausted. Thence it is 300 feet to No. 2, and in succession they are apart 2 to 3, 230 feet; 3 to 4, 280 feet; 4 to 5, 450 feet; 5 to 6, 370 feet; 6 to 7, 300 feet; 7 to 8, 380 feet. They are all on the foot except No. 4, which is sunk vertically in the hanging wall, but reaches the ore at the third level. Shafts to the west of it are to the dike and the ore is practically worked out, and in No. 4 is just about to the dike as it appears a little west from the bottom of the shaft. The dike pitches down steeply to the southwest and the ore follows it down. Thus the levels shorten on the west and lengthen to the east. Also as depth is reached the ore becomes necessarily narrower if the dike keeps the same pitch to the south. The foot wall dipping north and the dike south they recede from each other as they go up. The third level and above have been worked out except shaft pillars. In No. 4 shaft the third level is 300 feet long—150 feet each way from the shaft, east and to west, and 120 feet wide. The ore has all been taken out clear up to the capping and the timbers do not show any strain. They stand as perfect as when first put in. It is the intention to do the same in the fourth level, leaving a floor between the levels of about eight feet thick. The cap rock is very firm and hard. The fourth level extends east nearly to No. 6 shaft, having a uniform width of 10 sets, 75 feet, and a total length of 550 feet. They are mining now in several rooms in the fourth level. The ore has gone under the capping more than 200 feet east,

beyond the end of the third level. Both No. 4 and No. 6 are sunk to the fifth level and it is opened, thus far, 150 feet east of the latter. The breast, of course, still in ore and the opening work going forward.

Between the main foot wall drift and the ore north of it is a barrier of rock, 22 to 35 feet in width, which has to be drifted through to open the rooms. They open rooms three sets wide, leaving three set pillars. At the time of my visit, June 1, they had opened east to room 23. A little singular was the fact that room 21 is not separated by rock but the ore extends across from foot to hanging.

There is one main dike that underlies the ore from the west line which from its pitch at No. 4 shaft is a long way below the bottom at No. 6 and will be still far deeper at the east line; but nearly all the shafts have cut small dikes, which are probably branches from the main one; they have not materially affected the ore. Nos. 7 and 8 both bottomed in a dike at a depth of 130 feet. The ore was all worked out above the bottom and penetrating below the dike did not discover any ore. This dike is above the one which holds the ore at the west part of the mine and underlies the ore in the Norrie mine. The Norrie people are taking the ore above this dike in their shaft over the line. It remains to be seen if the ore follows the main dike east and continues on under this one at No. 7, etc.

At No. 3 some effort has lately been made to find ore below the dike through which the shaft was sunk. A diamond drill has also been used and borings made to a depth of 200 feet below the present bottom, but no ore was found. It is contemplated to sink the shaft several hundred feet deeper or until ore is found and to explore the ground.

No. 4 shaft is 350 feet deep and No. 6, being in lower ground, is 320 feet to the same level. No. 5 is sinking and rising and will be soon, also, to the fifth level, when the three will be the hoisting shafts to which the new machinery will be applied.

The fifth level is already more than 800 feet long and is likely to extend to very much greater length east. The water will all go to No. 6, which will have a Cornish pump to take it to the surface.

Mr. Alton L. Dickerman, M. E., the new Superintendent, who has been in charge since last November, has pushed things with energy and success. He is a highly educated gentleman and possessed of a large and varied mining experience. The Ashland company are fortunate in securing so reputable and efficient a manager.

Chas. C. Colby, President, Milwaukee, Wis.; John A. Taylor, Mining Captain; W. J. Olcott, Mining Engineer; E. A. Hayes, Manager.

The estimated product for 1889 is 175,000 tons.

The mine has produced annually as follows:

Year.	Tons.	Year.	Tons.
1885	6,471	1887	175,561
1886	74,015	1888	164,134
Total			420,181

THE NORRIE

leads all the mines in the State in the matter of product. Its output in 1888 of 411,000 tons was the largest ever made from any mine in this State, and the estimated yield of 500,000 tons for 1889 is also in excess of any other. The Norrie proper consists of 80 acres S. ½, S. E. ¼, Sec. 22, joining the Ashland, and with the East Norrie, which is also 80 acres, W. ½, S. W. ¼, Sec. 23, the Co. has three-quarters of a mile east and west on the range, and they are mining almost the entire distance. There are 11 shafts and they are hoisting ore from ten of these, while the remaining one will soon also be a main working shaft. It is a long mine and the bodies of ore are exceedingly wide. The stock piles are very large and the ore is coming up with great rapidity. A half million tons of ore from a single mine in one year, that last season produced nearly a like amount, is an enormous yield, that, too, from a mine that is barely four years old; for the first blow was struck in the spring of 1885, and the location was then all forest. Withal it is good ore, averaging—the entire product—62 per cent and upwards in iron and about .040 per cent phos. When work was begun at the Norrie not much was known about the situation or magnitude of the ore. The rocks are deeply covered with drift, so that the line of the quartzite was not sufficiently well known to locate the shafts on it. They were started vertically down until the foot wall was reached, when they are sunk on an inclination to the north in the quartzite. Thus there is not much system or regularity about the arrangement of the shafts. They were started haphazard, possibly exploring pits that were continued down and made into working shafts. Thus, unfortunately, there is a triangular prism of ore lying south of the shafts in the main part of the mine. On this, in a great measure, are the railroad tracks, stock piles ore pockets, etc. They should be south of the ore wholly, on the foot wall, and must be, ultimately. There is a peculiarity in the foot wall in the Norrie that I have observed in no other mine on the range, which is the fact of its flattening out to the north in the west part of the mine. As, for instance, No. 3 shaft was sunk vertically to the foot wall

which it follows to the third level, where the wall goes off flat 100 ft. to the north, and in the fourth and fifth levels they have cross-cuts in the foot wall to the ore, 140 ft. in the latter, from the shaft. The mine is all opened and worked after one uniform system of pillars and rooms, each made three sets wide, about 21 ft. From about No. 3 shaft to No. 6, which are 850 ft. apart, the surface has sunk down, filling the rooms to the fourth level with dirt, etc., and the ore pillars in the upper levels in this portion have been, in a measure, mined out.

There is a world of ore in the mine in the pillars that it is policy to stope away as fast as possible, while the timbers are sound and well in place. The ore has gone off so far to the north owing to the peculiar flattening of the foot wall that at the bottom it is well over towards the north line of the property. The lease of the land to the north has been secured, so that if there is ore in it the company can arrange to mine it. In fact No. 8 shaft is north over the line of the Norrie 80 and just west of the East Norrie it is vertical, 315 feet deep to the fourth level and from the bottom both mines are reached. The ore that is hoisted in it comes from the Norrie. No. 1 shaft is on the west side near the Ashland line and they are mining on the dike both in this and in No. 2—the same dike that cuts out the ore in the east end of the Ashland. They have worked up to the line. The ore in bottom lies in a trough on the foot wall and dike and each level is limited to west by the "cap rock," that also inclines down about parallel with the dike owing to the foot wall being very flat and also the dike that cuts it. The ore is wide—100 feet, 160 feet, 200 feet, varying from No. 1 shaft to No. 6. The mine is one great lense, that is worked in, the whole length of the property. It is underlaid by the dike and the foot wall and is very wide all the way. It is opened the entire distance, except for a short space west of No. 7, which latter will be to the fifth level soon, as they are rising and sinking in it to connect. It is on the foot wall. There are occasional bunches of rock in the ore but the ore itself is clean. Besides the underlying dike, which forms the bottom of the ore deposit, there is a small dike extending through the mine; it occurs in all the shafts from No. 2 to No. 6 and is about five feet thick. Immediately under it the ore is harder but does not cut out.

The water is taken up No. 6, where, at fourth level, is a No. 10 Knowles pump capable of hoisting 600 gallons 1,000 ft. per minute. A fire caught here Christmas night, which threatened to be a serious affair for a time, but fortunately was extinguished in a few days and not much damage done. The mine is one level deeper than a year ago, being now to the fifth, 420 ft. down as the shafts go.

In the East Norrie is a fine body of ore coming from west of the line and in the fourth level it gives a working length of 450 ft. and width of about 70 or 80 ft. The fifth level will be longer; they have not reached the cap rock east yet in the fifth level. The first level is worked out to the sand and the second has only pillars left; the others are stoped in. No dike in the bottom, but there is a crossing of dike material mostly. It is about 18 ft. wide and dips steeply to the east.

Apparently the Norrie and East Norrie are one continuous body of ore underlaid by the same dike that dips southeast and extends through the property. No ore has been found under this dike as yet, but the Norrie owners express great confidence that it exists. They expect to find, by going deep enough, the Ashland ore, that is that the Ashland ore underlies the lense that they are working in. Mr. Curry speaks of sinking a deep shaft to reach this supposed underlying ore.

The Co. will soon have a new plant of machinery, 12 ft. drums, to operate Nos. 4, 5, 6 and 7 shafts. The machinery now is inadequate for the work. The mine has outgrown the equipment which sufficed for the earlier development work.

Notwithstanding that the machinery is too light and that the shafts are not well located, one can see that the mine is well handled. Capt. Trebilcock attends to the underground work and Capt. Day to the surface and to matters generally.

The fact that in so large a mine, working 900 men, only one fatal accident has occurred in four years shows how carefully matters are looked after.

The Norrie is operated by the Metropolitan Iron and Land Co.

The officers remain as heretofore: S. S. Curry, President, Metropolitan Iron and Land Co.; H. S. Haselton, Secretary; R. H. Hanna, Treasurer, Milwaukee; Jeff. D. Day, Superintendent; Wm. Trebilcock, Mining Capt., Ironwood, Mich.

The mine has produced annually as follows:

Year.	Tons.	Year.	Tons.
1885	15,420	1887	217,384
1886	124,835	1888	410,763
Total			768,402

In the above is included the product of the East Norrie, which produced in 1888, 55,144 tons.

THE AURORA MINE

joins the East Norrie. The property is in similar form as its neighbors on the west, that is one 80 the long way, north and south, and another 80 similarly east and west, making three-fourths of a mile in length on the formation. They had a continuous run of ore the whole distance, but it is worked out in the west part. The ore did not extend to great depth, being cut out by a dike that underlies all the ore in the mine. The mine now is in the east 80, N. ½, S. E. ¼, Sec. 23, what was earlier known as the Vaughn. In this they are within about 200 feet of the Pabst line in the bottom level. The mine shortens rapidly on the west and lengthens on the east. The dike under the ore lies much flatter than the corresponding ones do in the Ashland or Norrie.

The mine looks about the same as it did last year; it is one level, 80 feet, deeper, but has the same characteristics. Nos. 4 and 5 are to the fifth level and No. 6 shaft is sunk to the sixth. It is about 300 feet from surface to the fifth level. At No. 3 shaft in the fourth level the ore was 16 sets wide —120 feet—but the dike was reached in the bottom and the fifth level does not extend so far west and the ore is of less width. The ore rises up on the dike west and north, and as the foot wall is regular the ore will naturally tend to grow narrower in the lower levels. The shafts are numbered from the west; from near the west line to No. 2, 600 feet, is open pit. Thence to No. 3 is 500 feet. From No. 3 to No. 4 is 286 feet. No. 5 is 146 feet; further east is 300 feet deep, and thence east to air shaft is 177 feet and 266 further to No. 6. East of the latter the ore is narrow, varying from a few feet to 20 feet in width, averaging for a considerable distance about 10 feet. They take the ore all out here and use stull timbers. It is about 500 feet from No. 6 to east line; more than half the distance is opened and they are still going east; but the vein continues narrow. Possibly there may be ore off in the hanging. Unless more ore is discovered than now appears a few levels more at the east end will wind up the Aurora. However, they hope to find underlying ore. No. 2 shaft has been sunk through the dike 30 feet and 15 or 20 feet further of cap rock material where ore is found. Thus far it is only 10 or 12 feet wide. No. 2 is 200 feet deep. If another lense is found beneath the bottom dike it will be very fortunate for the company and will be valuable otherwise.

On the 28th of April, 1889, the mine took fire underground, in the vicinity of No. 4 shaft. As the mine is open at the ends the draught came from both ways and went up No. 4 with great intensity of heat. The timbers in this shaft were all burned out, but no injury was done otherwise. They are

now re-timbering the shaft. The ore in the Aurora is quite firm and hard; it stands well in the pillars as does also the overlying rock. The company works 350 men.

The title of the corporation is the Aurora Iron Mining Co.

The officers are Stevenson Burke, President; Andrew S. Upson, Vice-President; Franklin T. Ives, Treasurer; Charles F. Rand, Secretary. Office, 101 St. Clair street, Cleveland, O. Nat'l Hibbert, Superintendent, Ironwood, Mich.; —— Brewer, Mining Captain.

The mine has yielded as follows:

Year.	Tons.	Year.	Tons.
1886	101,037	1888	179,650
1887	154,095		
Total			434,782

THE NORTH AURORA

is an exploration north of the Aurora and west of the Pabst. The work has been going on for three years and Mr. Paulson, who I am told furnished the money, lost all faith in the enterprise and abandoned it. The machinery was sold, etc. But Capt. Matt Fitzsimmons, who has conducted the work, not wishing to relinquish the lease, continues to explore. Test pits have been sunk clear across the property, generally in slate. The main shaft is 264 feet deep and they drifted north 274 feet, also west 70 feet. The dump pile shows considerable lean ore. The ore found was not good enough to be salable. Work at this shaft was discontinued and Mr. Fitzsimmons began another one 200 feet further west which is now about 40 feet deep and in a cherty schist that outwardly looks like slate ore. Across the fracture, however, it shows mostly rock.

THE PABST MINE

is one of those that shows great improvement. On the foot wall—quartzite—where the ore is generally found, the Pabst Co. did not succeed very well. They found ore, but not in large body. A shaft was sunk 360 ft. north of the foot wall near the east line; it was placed to find the Iron King north vein ore, that was mined in a little way to the east. The undertaking was a success, the ore was found, but at first was too sandy. Now, however, at the fourth level, 50 ft. lower down, the ore is all right. The ore is reached by cross-cut 60 ft. north through rock and thence the ore is opened east to the

line and west they are still advancing in ore. The level—fourth—is about 550 ft. long, and the ore attains a maximum width of 130 ft. and a minimum of 35 or 40 ft.

The fifth level does not open so well. It is 360 ft. from surface and the cross-cut from the shaft meets the dike and the ore going west is narrow, about the width of the drift. East is the dike and they are rising up on it in ore one or two sets wide.

The peculiarity of the dike that underlies the ore in the Pabst and in the Iron King mines is that it dips to the southwest. It lies pretty flat, but with a slight dip southwest. Here in the Pabst it is 360 feet from the surface, and at No. 5, east end of the Iron King, it is 150 ft. In the bottom of the Pabst the schist stands edgewise on the dike, plainly showing how the latter cut through the formation. They are boring with a diamond drill in the bottom. The drill is turned to the north, horizontal; is in 200 ft. in rock.

They are also sinking another shaft—B—which is 500 ft. west from the A shaft. It is now 175 ft. deep. They expect to find the same ore at a greater depth. The shaft is in the schist, designated as "cap rock," that contains the ore.

Nothing is doing in the foot wall shafts, except in No. 2, and not much in that. It is 364 feet deep. The company work 180 men and have 40,000 tons of ore in stock, or rather have mined that amount so far this year—June. Eighty thousand tons have been sold and they expect to get out 100,000. In A shaft the ore runs up to the sand in the third level.

It is possible—in fact it is quite probable—that the dike in the Pabst is the same one which underlies the ore in the Aurora, as it certainly does in the Iron King.

Since I went through the mine a few days ago it has been sold, so reported, to the Norrie people—Metropolitan Iron and Land Co., consideration being $400,000. The lease only, not the realty. This mine, as are the others in the Gogebic, is held on a royalty; the companies pay the owners of the fee 50c. per ton for the ore mined. The Pabst yields both first and second class ores. The latter is found along the foot and is but a small portion of the entire product.

The officers remain as heretofore, Fred Pabst, President; Chas. Best, Jr., Vice-President and Treasurer; Henry Baetz, Secretary and General Agent; W. W. Stephens, Superintendent.

Offices, 917 Chestnut st., Milwaukee, Wis.

Mine office, Ironwood, Mich.

The mine has produced as follows:

Year.	Tons.	Year.	Tons.
1885	1,153	1887	19,906
1886	17,925	1888	49,977
Total			88,961

Adjoining the Pabst is

THE IRON KING,

which like the former has both foot wall ore and north ore. There has been considerable surface improvement within the year past. The main engine house has been removed to the solid ground south of the quartzite, and also the machinery and engine house from the Valley location have been removed from there and placed at the Iron King and connected to operate the south vein shaft. This (A) shaft is 255 ft. deep, sunk a little way in the quartzite; it is in good shape, skip, etc. The ore in bottom is opened 100 ft. each way from shaft, east and west, and is 65 ft. wide; about 75 ft. high, all roomed out one set high. The ore is about 58 per cent to 59 per cent iron, 4 per cent manganese and .040 per cent phosphorus. The mine is all opened to work, no water; the north mine drains it. There is a dike at east end, which dips southeast so that the ore is under it. The dike is 14 ft. wide. They have cut through it. A new shaft, No. 4, has been sunk recently; it is in the north vein. I like the plan of Capt. Jones' shafts, skip way, timber way and ladder, each separate and independent of the others. The shaft is 250 ft. deep to the dike and are drifting west on the dike to connect with No. 3. The bottom is narrow. The foot wall and dike come together forming a trough, in which is the ore. Higher up the ore widens out. Near No. 3 it is 75 ft. wide. There are about 50 ft. more to drive to connect.

No. 1 shaft near the west line is 360 feet deep down to the dike to the limit of the ore. Rising up, however, the ore becomes rapidly wider—75 feet—but it is pretty well exhausted. The dike lies so flat that in the upper sets tram tracks are used to run the ore out to chutes that take it down to the main drift. All there is of the bottom of the lower level is a drift. The ore goes up to the north and to the south on the dike and on the foot wall and must be run from above to the main drift. Capt. Jones is managing this work with skill and economy. No. 1 is 191 feet east of the Pabst line. No. 2 is 356 feet deep, 209 feet east of No. 1. Like all the others it is to the soap rock and apparently to the limit of the ore. Since No. 3 was

sunk to a depth of 405 feet, 50 feet below the ore, through the dike, but no ore was found below. The dike was 17 feet thick. They talk of using a drill. Between Nos. 2 and 3—202 feet—the ore is all worked out except three pillars.

Apparently the mine cannot last very long unless more ore is found than now appears. From No. 3 west to the Pabst line the ore is pretty well exhausted. This portion of the mine has furnished the product for the last two years. The ore is all, throughout the mine, cut off by the soap rock. No. 5, away to the east, is 150 feet deep to the dike.

A day or two after I went through the mine the large mining boarding house burned. And since then I also learn that the mine has closed down owing, it is said, to the financial affairs of the company.

There is no ore in stock at the mine; it has been sent to Chicago as fast as mined.

The mine is now held and operated by the Bessemer Consolidated Iron Company. M. W. Burt, Assistant Manager, Ironwood, Mich.; E. H. Jones, Mining Captain. More recently still the mine has been taken possession of by the bondholders, and is thus no longer operated by the Bessemer Consolidated.

The mine has produced as follows:

Year.	Tons.	Year.	Tons.
1886	27,343	1888	69,145
1887	74,609		
Total			171,097

At the Bonnie, First National and Blue Jacket no work has been done in the past year. Mr. S. S. Curry and Capt. Day, of the Norrie, were examining the First National with the view to the production of manganese or of manganese ore.

THE RUBY

is a mine that has failed to hold out according to the expectations early entertained regarding it. I have described the mine fully heretofore and will not now enter into details. It is a property that affords abundant indications of ore but if any considerable bodies of clean ore exist on it they must lie deeper than they have yet penetrated; for the surface has been pretty well test-pitted and mainly mixed ore and rock found. The company has produced a small amount of ore the past year and has continued

the work of sinking No. 4 shaft, which is now—June, 1889—355 feet deep. At 320 feet a dike was encountered and they went through it and below it. As usual only the same rock was found below as above the dike. At the 200-foot level they had ore east of the shaft 60 feet long, but at the 300-foot level it is smaller; are working in it now. They are working 30 men.

The following is the product:

Year.	Tons.	Year.	Tons.
1886	16,388	1888	3,056
1887	42,065		
Total			61,509

Wm. Bice, Superintendent, Bessemer, Mich.; S. Hitchcock, Secretary, 101 St. Clair street, Cleveland.

THE IRONTON IRON MINING CO.

has sunk the shaft following the diamond drill boring that is described in Report of previous year. They sunk 100 ft. and made cross-cut of 17 feet north to ore. At the time I was at the mine they had not fully determined the magnitude of the deposit. They had just begun that day to hoist ore. It looked promising. Beyond this nothing has been done, and it is not necessary that I should enter into particulars that have previously been dwelt on.

The mine has produced as follows:

Year.	Tons.	Year.	Tons.
1886	16,307	1888	1,755
1887	27,887		
Total			45,949

M. W. Burt, Vice President; Geo. H. Abeel, Superintendent, Bessemer, Mich.

THE FEDERAL LAND AND IRON CO.

holds the Tontine, which property joins the Ironton on the east. The new Co. has kept to work moderately with good success. The drifting has been extended east and at 400 ft. east from the shaft and in the foot wall are sinking a new shaft, which is now down 80 ft., inclining north 67° and is 6′x12′ inside the timbers; to be divided into three compartments, skip, timber and ladder way. The old shaft is 175 ft. deep and the drift east is 300 ft., all the

way in ore, but not all the way in good ore; in one place 40 ft. wide of pretty fair ore. Have opened out six sets wide and gone up two sets, and are still rising.

At about 240 ft. east of the shaft is the best ore, 60 feet in length of it, but have not cross-cutted to ascertain the width. This end of the mine will be developed from the new shaft. I went underground and examined the workings. The indications are favorable, certainly.

The officers are M. H. Branch, President and Treasurer; R. S. Dingwell, Secretary, Milwaukee, Wis.; D. H. Bennett, Superintendent, Bessemer; R. Stepan, Mining Captain, Bessemer.

The product in 1888 was 3,182 tons.

The lease of the Valley mine has been thrown up and nothing has been done there for a year and more past.

THE COLBY MINE

is now operated by the owners of the fee, the Penokee and Gogebic Development Co., the lease under which Pickands, Mather & Co. had worked the mine having expired last November. The officers of the mine are Charles L. Colby, President, James L. Colby, Treasurer, Milwaukee. Local officials are: W. E. Dickinson, Superintendent; John Gilchrist, Assistant Superintendent; James Piper, Mining Captain; N. J. Cavanaugh, Time Keeper; H. E. Williams, Chemist; George D. Swift, Book-keeper; James P. Smith, Ore Shipper; W. H. Colbate, Supply Clerk.

The mine had 80,000 tons of ore in stock at the opening of navigation and but a small force had been worked during the winter—300 men and less. Capt. Dickinson, the new Superintendent, is well and favorably known in mining circles on Lake Superior, having long been engaged in mining work in that region. He has already made great improvement in the appearance of the surface about the mine. The buildings, standing over the mine, have been removed to safe ground and some new ones built, in which are included a laboratory, warehouse, boiler house, etc. Among the important things done recently is the sinking of a shaft from the surface in the foot wall south of the ore 30 feet. The shaft is double skip, 22′x6′ inside timber, descending to the north at an angle of 60°. This shaft will take the ore in the east end of the mine. It will be remembered that the ore, at first worked in two deposits, called the north and south veins, was really one great body of ore resting on the quartzite foot wall on the south, and the intersecting dike that cuts it, that comes down from the

northwest, dipping southeast across the formation, and thus constituting the main floor of the ore.

The Co. began mining the ore at the west end at the surface in both deposits and have followed down in the ore on the dike. The rock above the ore is a cherty, ferruginous schist that dips with the formation; it is the same below as above the dike. As the dike inclines east at an angle of about 30°, it will be seen that the levels must lengthen in succession east and shorten west. The levels are about 600 ft. in length, but the total distance between the extreme east and west points of the mine is more than twice that space. The bottom level is the sixth, which has been sunk to and opened during the past winter. The ore is not as wide, but holds the same length as above. That the ore continues on east at greater depth has been proven with the diamond drill set in the fifth level, 360 ft. east of No. 4 shaft. The first boring at an angle of 20° depression from the horizon found the capping. A second hole descending at an angle of 45° is in ore all the way as far as the eighth level.

The foot wall mine is still held up by the ore pillars, of which there are some very large ones; as, for instance, in the fifth level there are three, which are 40 or 50 ft. wide and 100 ft. long. One pillar at No. 3 shaft is 80x120 ft. There are ore pillars in all the levels, which will be taken some time. The trouble with taking out the pillars is that the "capping" is so firm that it will not readily come down, so that they cannot run the surface to fill the rooms. The sixth level is at about 150 ft. from the east line of section 16. If the ore holds, the mine will be in section 15 in time.

The most improved showing found in the mine is in the second level east, where a drift was made east through the rock capping to reach the new—No. 5—shaft. After cutting through 20 ft. of rock a body of ore was found in which they had penetrated east 120 ft. and were still going on in ore at the time of my visit, June 1, 1889.

This indicates another overlapping lense of ore; certainly a very fortunate circumstance.

The East Colby, the shaft away east in Sec. 15, is to the fourth level, the shaft having been sunk an additional 60 feet.

The shaft descends on the south foot wall, 65° north. The old workings are all crushed in, but the new level is opened for a length of 80 feet, width of 40 feet ore.

The Colby mine ore contains quite a percentage of manganese but not enough to add to its value; in fact it holds just enough to make it less wanted, so that it does not sell readily at such price as the company holds it at. The mine could produce 1,000 or 1,200 tons daily now if there were sale

for the ore. The company owns three contiguous quarter sections of land. The mine is in the city of Bessemer, not far from the center of the city, at an elevation above it of about 200 feet. The outlook from the surface of the mine is very fine.

The mine has produced as follows:

Year.	Tons.	Year.	Tons.
1885	84,312	1887	258,518
1886	257,433	1888	285,195
Total			885,458

Since writing the foregoing the labor force has been reduced to about 140 men, total of employés. The trouble is with the ore—too little sale for the grade of ore that the Colby produces.

THE PALMS MINE

continues to improve. Each successive level opens up a larger store of ore. At the beginning of 1888 there was scarcely a pound of ore in sight, and yet before the season closed the company had shipped 23,184 tons of ore, and I judge that 30,000 tons will scarcely be the limit of the output in 1889.

The work is mostly in No. 3 shaft, 300 ft. to the first working level, which furnished the most of last year's product. They have gone west 265 ft. and east 176 ft. Going west the ore was at first narrow, but opened out to four sets wide, 30 ft., and three or four sets high; but most of the way the ore was only one set high. The bottom is all ore and they are coming in under it at 50 ft. further down, and it appears to be of equal dimensions with the advantage of being 50 ft. high. East the mine is greatly improved. Where above was all rock is below ore. There was a narrow vein of ore along on the foot wall about four ft. wide; now, below, the ore is 30 ft. wide, and they are east of the shaft 100 ft.—still ore. In this lower level only the drift is made and a cross-cut ready to stope both ways. It is good, soft ore, clean, and is Bessemer.

If the mine continues to improve in this way as they go down it will soon be an important producer. They are also sinking No. 4 shaft, which is 300 ft. west of No. 3, and is now 222 ft. deep—May 25, 1889. The Co. employs about 60 men and has about 10,000 tons of ore in stock.

Wm. Irvine, Treasurer, Chippewa Falls, Wis.; J. P. Christopher, Supt., Bessemer, Mich.

Product—1887, 1,600 tons; 1888, 23,184 tons; total, 24,784 tons.

THE ANVIL MINE

has a body of ore resting on a flat dike. In other words, the company has reached an underlying dike, which apparently limits the ore downward. Throughout the mine in the bottom, a little way under the ore is the soap rock. Away to the west end the dike shows a tendency to rise up to the west. No. 2 shaft is down to the bottom, 331 ft., and they have gone west under No. 1 and beyond it to within 150 ft. of the Palms line, 336 ft. in all. West in the bottom are two rooms in the ore, each five sets, 35 ft. wide, and 12 sets, 84 ft. long. There are also two pillars, each 28 ft. wide, and they are still going west, but beginning to rise on the dike. The ore next to the dike is hard. The body as a whole is very soft ore, and in the lower level, of good quality—62.70 per cent in iron, .040 per cent phos.

At 500 ft. east another shaft is sinking, which is now down 190 ft.—is 6′x10′ in size inside the timber; is on the foot wall, all the way in rock. It will be sunk to the fourth level, about 400 ft. deep, and then they will explore for ore.

The estate consists of a ¼ section of land, admirably located on the iron range.

The corporation is the anvil mining Co., W. H. Brand, President, Milwaukee, Wis.; R. S. Dingwell, Secretary, 377 Broadway, Milwaukee; D. A. Bennett, Superintendent, Bessemer, Mich.

Product of the mine in 1887, 10,076 tons; 1888, 24, 677 tons.

THE BROTHERTON MINE

shows very little change. It looks neither better nor worse than it did a year ago. It is simply 50 feet deeper, but the lower level is almost identical with those above. It is a long mine, extending east from the margin of Sunday lake across the property to the Sunday Lake mine. The ore is divided into two separate bodies which they call the south vein and the north vein; the former has improved somewhat. It is a "pockety" mine; the ore requires a good deal of looking for. Capt. Bawden states that he has done about 1,000 feet of rock drifting and cross-cutting in the past year, much of it in search of ore. The mine is well handled and the ore is, I think, economically mined. It is the best of Gogebic range ore; two recent cargoes averaged 62.50 per cent iron, .035 per cent and .037 per cent phos., 6 per cent silica.

There are 23,000 tons of the product for 1889 already mined—June—and it will be increased to 60,000 tons and more before the end of the season.

There are three shafts, all producing ore. The west one, No. 1, is 260 feet deep to the fifth level and is about 500 feet east from the margin of the lake, measured in the line of the ore. They have not ventured to go under the lake yet, but will do so at greater depth. There is a length of ore of 350 to 400 feet with a width of 20 to 40 feet. The shaft is in the south vein and they drift north to the ore. No. 2 shaft is in the rock between the two veins and is 210 feet deep. It is 500′ from No. 1 and the two are connected underground. The ore is about 200 feet long and 10 or 15 feet wide. No. 3 on the hill, 175 feet west of the east line, is also 500 feet east of No. 2; it has a "run of ore" of about 250 feet in length and 15 or 20 feet wide. In all these pits they mine out all the ore, letting the surface cave down.

The Brotherton, Sunday Lake and Iron Chief are the only mines east of the Black river that have produced ore to ship. The quartzite foot wall, so important a feature further west, is wanting here. Also no dikes have as yet appeared. The ore occurs in pockets in the cherty schist, making the foot, hanging, etc., rock, all the same. The formation west and east of these mines is identical with this, but notwithstanding no ore in quantity has been found at the other explorations.

Near the Brotherton, etc., is the village of Wakefield which so far as buildings go is quite a large town; but just now many of the dwellings and places of business are vacant. Much is hoped for in the future of the gold mines near here.

Joseph Sellwood, President, Duluth, Minn.; Richard Bawden, Superintendent, Wakefield, Mich.

The mine produced in 1886, 8,880 tons; in 1887, 21,721 tons; in 1888, 40,639 tons; total, 71,240 tons.

THE SUNDAY LAKE MINE

is idle, awaiting, I am told, the final settlement of legal controversy regarding the property. The only work doing is drifting cross-cut south exploring for ore. There are no stopes opened in the mine. It will be necessary to sink before ore can be mined. Everything remains as last year, the mine underground is not materially different.

Mr. Duncan McVichie still acts as superintendent. Geo. M. Wakefield, Milwaukee, is, I believe chief owner of the fee.

The mine produced in 1886 14,270 tons of ore, and in 1887, 18,138; total, 32,408 tons. No product in 1888.

The Iron Chief has been abandoned, and still further east are the Pitts-

burg, Commercial and Eclipse, of which there is nothing very much to be said. They cannot be said to be mines yet. They are still explorations.

Capt. Tallon is working a few men at the Pittsburg, and the prospects for ore are about as they have been for two years past.

West of the Brotherton there are several explorations where work is in progress, as for instance,

THE CROWN POINT,

which owns a narrow strip of land along the north margin of the lake, a fractional ¼ section. A new shaft was recently sunk 40 ft. and came into a deposit of ore 10′ or 12′ wide, in which they drifted west 60 ft. It is not clean ore, there is too much rock in it, but it is an improvement on any heretofore found on this property, or on the others near it.

AT THE ALPHA

I found them pumping out the water from the shaft, preparatory, it was stated, for further work.

THE SPARTA,

formerly the Chicago, which joins the Crown Point on the north, is sinking a shaft close to the line only 90 feet north of the shaft in which the Crown Point ore is found. Capt. John McLeod, who superintends the work, feels quite sure of finding ore at a depth of 150 feet; is now—June 5—115 feet deep, working 11 men; has pump and steam hoist; 80 acre tract.

Capt. McLeod is also conducting an exploration on the 80 west of the Chicago—E. ½ N. E. ¼ Sec. 8, T. 47, R. 45. A shaft. which is now 65 feet deep, is still going down. Capt. McLeod has ranged out the line of the Brotherton and Sunday Lake mine ore and got into the western continuation of this line and is thus conducting his exploration.

AT THE PILGRIM

exploration a good deal of perseverance has been shown. The shaft was continued down to a depth of 208 feet and a cross-cut driven south 400 feet. I have not been into this long drift as I intended to have done but I learned from Mr. George H. Abeel, the Superintendent, that it was all the way in schist—cherty schist, containing traces of ore, leaving off at south end in black slate. I judge that the gentlemen who have done so much here have become discouraged and are likely to abandon any further work.

There are other explorations, the East Anvil and the Mikado for instance, that are yet held to be of some value. Others still are worked a little, just enough to hold the option. A far greater number are hopelessly abandoned.

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